Mirage F1

Restricted

FLIGHT MANUAL

AIRCRAFT OPERATING INSTRUCTIONS

1F-F1K50CZ-1-1

Restricted

7610-18-424-7097 51Fm/1/1

FLIGHT MANUAL

AIRCRAFT OPERATING INSTRUCTIONS

MIRAGE F1CZ

AIRCRAFT

DASSAULT AVIATION

RESTRICTED

JANUARY 1975
CHANGE 14 JUNE 1990

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LISTE DES DECISIONS DE MODIFICATION AYANT ENTRAINE UNE MISE A JOUR DU MANUEL

LIST OF AIRCRAFT MODIFICATIONS WHICH HAVE RESULTED IN MANUAL UPDATING

Original issue of January 1975 including the following :

- Issue for approval of September 1974
- "Vetting" of January 1975
- Modifications approved up to 10th general issue of modification sheets, dated 24/12/1974 inclusive.
- Change No. 1 including modifications approved up to 14th general issue of modification sheets, dated 10/7/1975 inclusive, plus modification FX34.
- Change No. 2 including modifications approved up to 18th general issue of modification sheets, dated 23/12/1975 inclusive.
- Change No. 3 including modifications approved up to 21st general issue of modification sheets, dated 12/10/76 inclusive, and provisional changes Nos. 001-002-003-004-005-006.
- Change No. 4 including modifications approved up to 26th general issue of modification sheets, dated 24/2/1978 inclusive, and provisional changes Nos. 007-009-012.
- Change No. 5 including modifications approved up to 27th general issue of modification sheets, dated 17/01/1979 inclusive, and provisional changes Nos. 013-014.
- Change No. 6 including provisional change No. 016 and the new instructions for operational procedures approved by the French Air Force.
- Change No. 7 including modifications approved up to 28th general issue of modification sheets, dated 7/11/1980 inclusive, the new engine procedures approved by the French Air Force, and provisional changes Nos. 17-20-22-23.
- Change No. 8 including modifications approved up to 29th general issue of modification sheets, dated 17/11/1981 inclusive, and provisional changes Nos. 024 and 025.
- Change No. 9 including new instructions relating to :
  - illumination of [EMG~] light in event of alternator failure
  - engine relight speed
  - illumination of [OIL] light when engine starts

  and provisional change No. 026
- Change No. 10 including modifications approved up to 29th general issue of modification sheets, dated 17/11/81 inclusive, and standardization of manual.
- Change No. 11 including modifications approved up to 29th general issue of modification sheets, dated 17/11/1981 inclusive, provisional change No. 030, and standardization of manual.
- Change No. 12 including provisional changes No. 031-032, and standardization of manual.

LISTE DES DECISIONS DE MODIFICATION AYANT ENTRAINE UNE MISE A JOUR DU MANUEL
LIST OF AIRCRAFT MODIFICATIONS WHICH HAVE RESULTED IN MANUAL UPDATING

- Change No. 13 including the new instructions for using the autopilot, and standardization of manual.
- Change No. 14 including provisional change No. 033, and standardization of manual.

List of modifications concerning pilots and incorporated in the flight manual (Books 1-2-3) upon change.

Changes No. 1 and 2

Modification No.	Corresponding Export No.	Description
260	FB 223	New marking for ancillary system hydraulic pressure gage.
322	FB 122 - 123	Installation of dome embrittlement device on canopy. Canopy dome embrittlement and modification of aircraft and ejection seat.
324	FB 81-125	System indicating altitude holding loss in transonic flight. VOR/ILS test disabling when autopilot is in glide slope mode.
352	FB 158	Dual feed valve on roll servo-control.
372	FB 222	New marking for three positions selecting external store jettisoning.
385	FB 188	New nose wheel steering light meaning.
390	FB 193	Jet pipe temperature indicating during ground standby.
394	FB 197	Rain-repellent equipment not installed.
400	FB 203	Nose wheel steering and shock cone control systems - new electrical power supply mode.
FX 38	FB 178 - 179	Autopilot - new heading selection principle.
FX 42	FB 218	Failure warning panel - new color for light repeating IFF failure and disconnection of circuit to warning horn.
FX 34	FB 263	Engine exceptional overspeed indicating.
417	FB 270	New thermal protection in engine compartment.
472	FB 289	Marking of locked position of brake chute control lever.
FX 44	FB 220	Autopilot computer unit - maximum roll angle change.
FX 64	FB 262	Ejection seat - change in time release mechanism operating altitude.
FX 68	FB 268	New placard for landing/taxi light control switch.

List of modifications concerning pilots and incorporated in the flight manual (Books 1-2-3) upon change.

Change No. 3

Modification No.	Corresponding Export No.	Description
443	FB 272	Cover on spherical indicator
491	FB 332	Automatic AB relight in missile firing mode after engine fuel dipping
FX 82	FB 302	Marking the "TEST" position of the weapon safety switch
493	FB 317	Extension of the inflight relight envelope, modification of the placard
413-453-479-491	FB 259-274-293-332	Gun-missile fuel dipper system, new definition

Change No. 4

FX67	FB 234	Survival pack with rigid box and new dinghy puncturer.
448	FB 257	Power supply of MATRA 530 automatic firing circuit slaved to U/C-up microswitch.
454	FB 331	Use of high lift flaps in combat configuration.
528	FB 357	Pilot's connection junction system - new device for anti-g port blanking.
541	FB 367	Addition of a guard on ARTHUR switch.

Change No. 7

496	FB 320	New searchlight.
601	FB 387	196 type sight computer - description of horizon assembly in every function except approach function.
671	FB 460	Sight camera Omera type 130 - new overrun setting values.

Change No. 8

746	FB 508	Replacement of clock light.
FX42	FB 218	Failure warning panel - new color for IFF failure warning light and cancellation of coupling with warning horn.

List of modifications concerning pilots and incorporated in the flight manual (Books 1-2-3) upon change.

Change No. 10

Modification No. (origin)	Corresponding export No.	Description
FX 28	FB 233	Conservation measures for carriage and firing of V3 missiles.

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AVIONS MARCEL DASSAULT BREGUET AVIATION F 6117	MIRAGE F1 AIRCRAFT PART NUMBER : F1

PHYSICAL CHARACTERISTICS

Clean aircraft gross take-off weight comprising :

- empty weight equipped	7845 kg (17, 295 lbs)
- pilot	95 kg (209 lbs)
- fuel - TR0 (JP1)*	3397 kg (7489 lbs)
- shells	145 kg (320 lbs)
	11, 482 kg (25, 313 lbs)

Overall dimensions :

- length	15. 25 m (50. 03 ft)
- span	8. 44 m (27. 69 ft)
- height (clean aircraft - fully fuelled)	4. 49 m (14. 73 ft)

U/C :

- wheelbase (clean aircraft - fully fuelled)	4. 87 m (15. 98 ft)
- track	2. 48 m (8. 14 ft)

Propulsion :

- SNECMA ATAR 9 K50 jet engine
  test bed thrust :

- Full power dry	4770 daN (10, 725 lbs)
- Max. A/B	6830 daN (15, 355 lbs)

*Reference specific gravity of fuel : 0. 79

TECHNICAL CHARACTERISTICS

Clean aircraft permissible load factor :

- in subsonic flight $M < 0.95$	- 3/+7. 2
- in supersonic flight $M > 1$	- 3/+6
Maximum speed	700 kt between 0 and 20, 000 ft 750 kt above 20, 000 ft
Mach number limit	2. 10
*Ceiling	55, 000 ft

*High altitude equipment is not part of aircraft specifications. Service ceiling is 50, 000 ft.

0,10 - PURPOSE OF MANUAL

The Manual of Operating Instructions consists of three books as follows :

- 1 : Aircraft Operating Instructions
- 2 : NWS Operating Instructions
- 3 : Performance

The purpose of the Manual of Aircraft Operating Instructions is to give :

- technical information concerning the descriptions and operation of the aircraft which is essential for its correct use
- normal procedures
- limitations
- emergency procedures
- flight characteristics

The manual is therefore not overburdened by theoretical considerations, or by technical or construction details, which do not directly concern the use of the aircraft. For complete information concerning complex systems, reference will be made whenever necessary to the general or specific technical documentation concerned.

CAUTION

ONLY THE PROCEDURES DESCRIBED IN THE MANUAL OF OPERATING INSTRUCTIONS ARE AUTHORIZED.
THE OPERATIONS OR CONFIGURATIONS NOT EXPLICITLY DEALT WITH IN THIS MANUAL ARE THEREFORE PROHIBITED.

0,20 - REVISION PROCEDURE

0,20.1 - IDENTIFICATION OF PAGES

Each page is identified by :

- the Manual No at the top R/H corner of the R/H page and at the top L/H corner of the L/H page
- the issue date of the page in the lower L/H corner (front page) and in the lower R/H corner (back page)
- the page No in the lower R/H corner (front page) and in the lower L/H corner (back page)

The page No is made up as follows :

- a first digit followed by a point indicates the Section No
- one or more digits followed by a dash indicates the Sub-Section No
- one or two other digits indicates the rank of the page within the Sub-Section
- the illustrations are numbered (from 1 to x) within each Sub-Section.

0,20.2 - UPDATING PRINCIPLE OF THE DOCUMENTATION

The updating takes place in two stages i.e. :

- Issuing of Supplements temporarily incorporated into the documentation.
- Revisions proper which consist in incorporating definitely into the documentation new information or previously issued in the form of Supplements (change of pages or addition of new pages).

0,20.3 - REVISION TO THE MANUALS

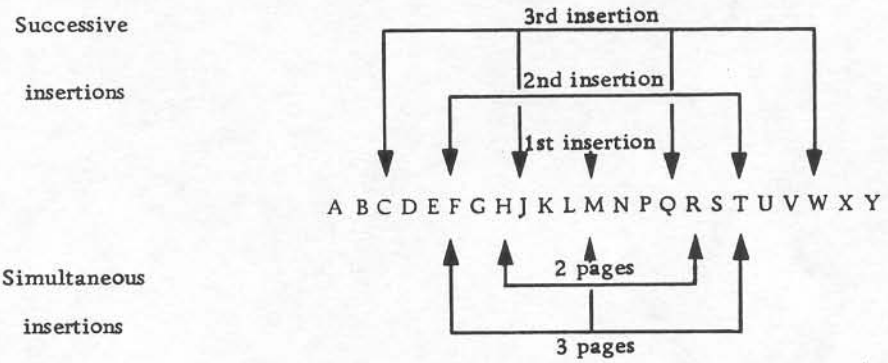
1 - Procedure

Revision involves two operations :
- insertion of new pages and replacement of changed pages,
- systematic replacement of the title page and list of effective pages.

2 - Page numbering

First case - Addition of one or more new pages following the last page of a Sub-Section.
The pages are numbered in the normal order.

Second case - Insertion of one or more new pages between two existing pages.
The new page(s) bears the number of the preceding page followed by a capital letter, with the exception of letters I, O and Z.
The letters are chosen in every case so as to provide for maximum further insertions unless the initial numbering sequence is changed.
The principle is illustrated in the table below :



Example :

Assuming that several pages are to be inserted in succession between pages 6 and 7. The first one will be numbered 6M, the second one 6F if it is to be placed before 6M, or 6T if it is to be placed after 6M. Similarly, if it is necessary to insert a third page later on, its number will be 6F or 6T, 6C or 6J, 6Q or 6W as applicable.

Assuming that the following are to be inserted simultaneously :
- 2 pages : they will be numbered 6H and 6R.
- 3 pages : they will be numbered 6F, 6M and 6T.

Third case : Insertion of a new page resulting from the application of an official modification. The principle consists in showing, simultaneously, in the documentation the two states : after modification and before modification.

(a) The revision is inserted, according to the procedure explained above, without changing the page numbering : thus a new page will supersede the previous page.

(b) If the fact of introducing the two states (after and before modification) increases the number of pages, the solution will be as follows :

- both pages, before and after modification, will bear the same number. The revised page will show the note "Post-Mod. X" above the page number (which means that modification X is applied). The two pages will be listed in the List of Effective Pages, with "Post-Mod. X" appearing above the page number of the new page.

REMARK : In general, these two pages will be given different dates.

(c) In the case where an entire paragraph or a Section is modified to a great extent by a revision (majority of revised pages), the entirely revised paragraph will be found first then the entire paragraph not revised. The two paragraphs (or Sections) will be shown in the Table of Contents.

The pages not revised will be deleted only at the time of a future revision once the modification has been applied on all aircraft.

3 - Identification of revised texts

The revisions to the text, addition or deletion, are identified by a vertical line on the L/H side.

The entirely revised pages are identified by a vertical line in the lower L/H corner.

0,30 - BREAKDOWNS

0,30.1 - FLIGHT MANUAL BREAKDOWN

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0	INTRODUCTION	Purpose of Manual		Revision to Manual		Breakdowns	
1	DESCRIPTION OPERATION	Airframe	Electrical System	Fuel System	Jet Engine	Hydraulic System and Brake Chute	Flig Contr and Flying Autop
2	NORMAL PROCEDURES	Before Starting	Starting Taxiing Takeoff		Normal Flight		Use of Autop
3	LIMITATIONS	Clean Aircraft	Electrical	With Stores	Engine		
4	EMERGENCY PROCEDURES	Takeoff and Landing	Electrical System	Fuel System	Engine	Hydraulic System	Flig Cont an Flying Auto
5	FLIGHT CHARACTER-ISTICS AND EXTREME WEATHER OPERATION	High Angles of Attack Spins			Specific Landings		

	35	40	45	50	55	60	65	70	75	80
wns		Abbreviations and Symbols Used								
ılic m hute	Flight Controls and Flying Aids Autopilot	Hydraulic Utility Systems	Flight Instrument Systems	Cockpit Layout	Pilot's Equipment and Associated Systems	Warning Systems	Radio System	Navigation System	Operational Equipment	Armament
	Use of Autopilot	Return to Parking Area								
		Elements Extended								
ılic m	Flight Controls and Flying Aids Autopilot	Hydraulic Utility Systems	Flight Instrument Systems		Pilot's Equipment and Associated Systems	Fire				
					Instructions for Starting and Taxiing Under Hot Conditions					Specific Store Carriage Instructions

0,40 - ABBREVIATIONS AND SYMBOLS USED

%	Engine Speed Read on RPM Indicator
rpm	Engine Speed Read on RPM Indicator
M	: Mach Number Indicated by Mach/Airspeed Indicator
IAS	: Speed Indicated by Mach/Airspeed Indicator
ΔP	: Pressure Differential
Hp	: Pressure-Altitude
ft	: Foot (Feet)
kt	: Knot (Knots)
i	: Angle of Attack Indicated by Angle-of-Attack Indicator
$\sim$	: Approximately
α	: Control Stick Travel
$\frac{\alpha}{1}$	: Full Travel
$\frac{\alpha}{2}$	: Half Travel

Warning Horn

Switch

Circuit Breaker

Manually-Operated Valve

Electrically-Operated Valve

Electric Relay

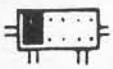
Time-Delay Relay

Pushbutton

Mechanical Pump

Electrical Pump

Non-Return Valve
(the arrow indicates direction of flow)


Dual Feed Valve

One-Winding Torque Motor

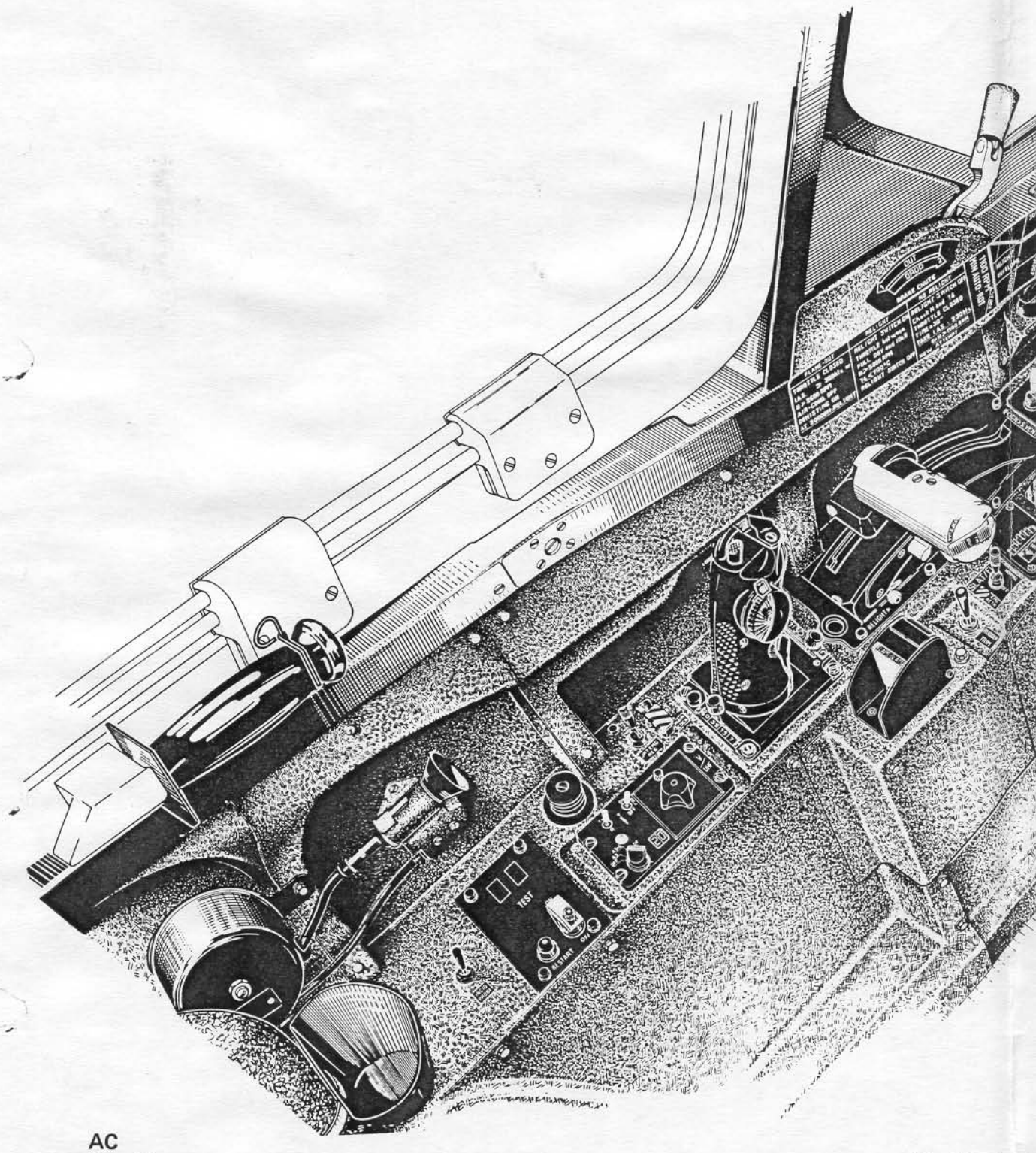
Two-Winding Torque Motor

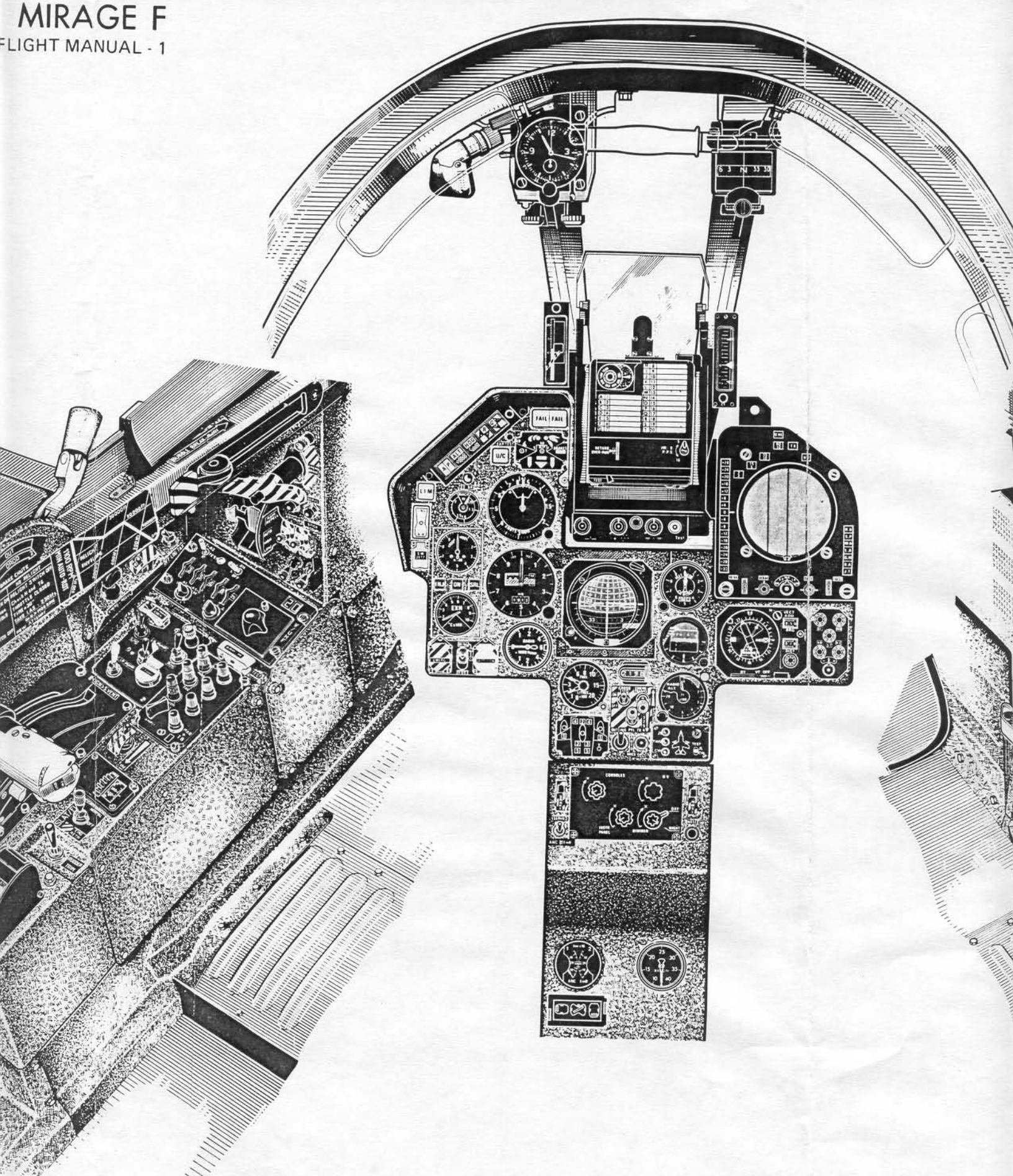
One-Way Restrictor Valve
(small arrow)

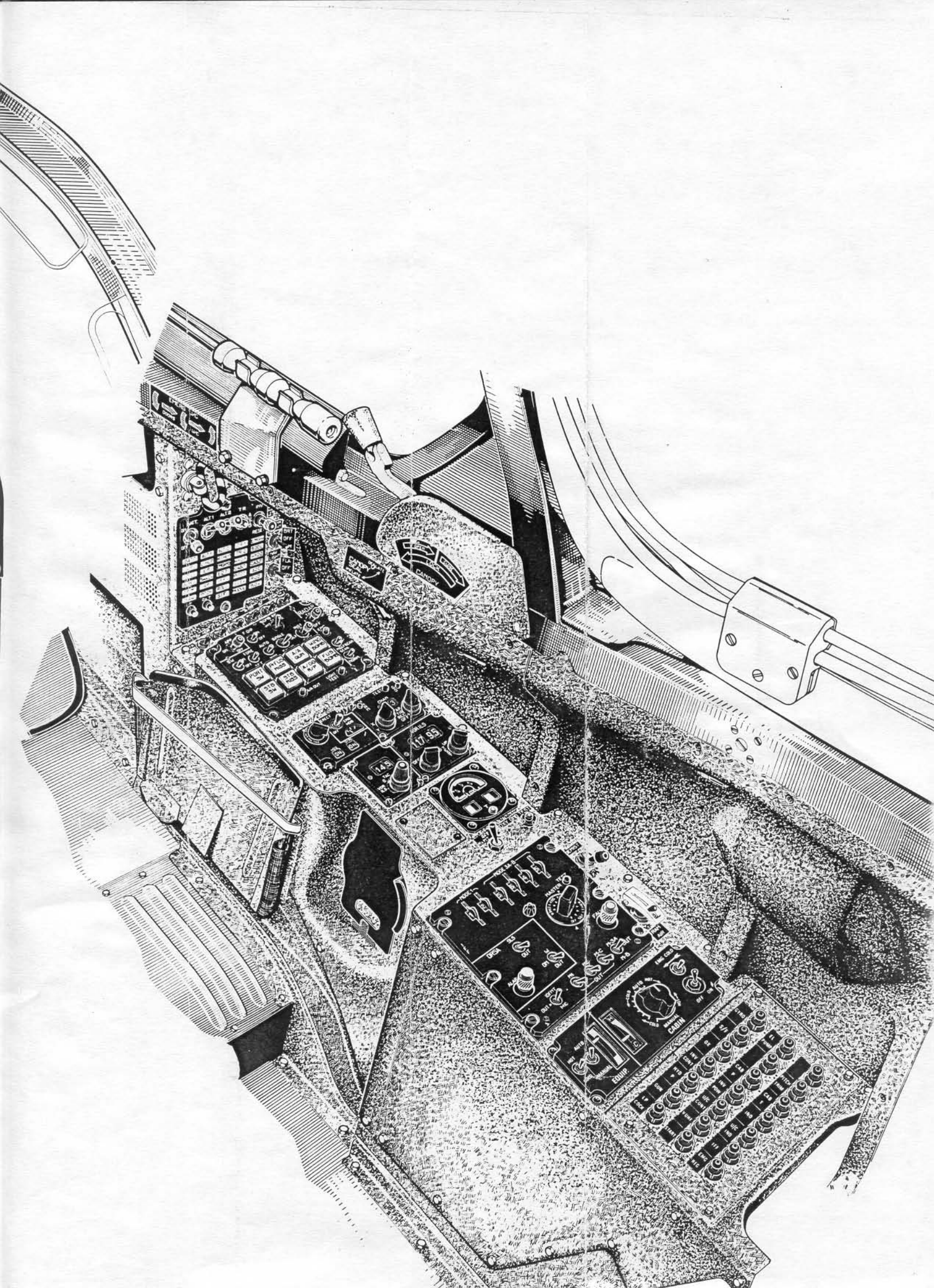
Pressure Tapping

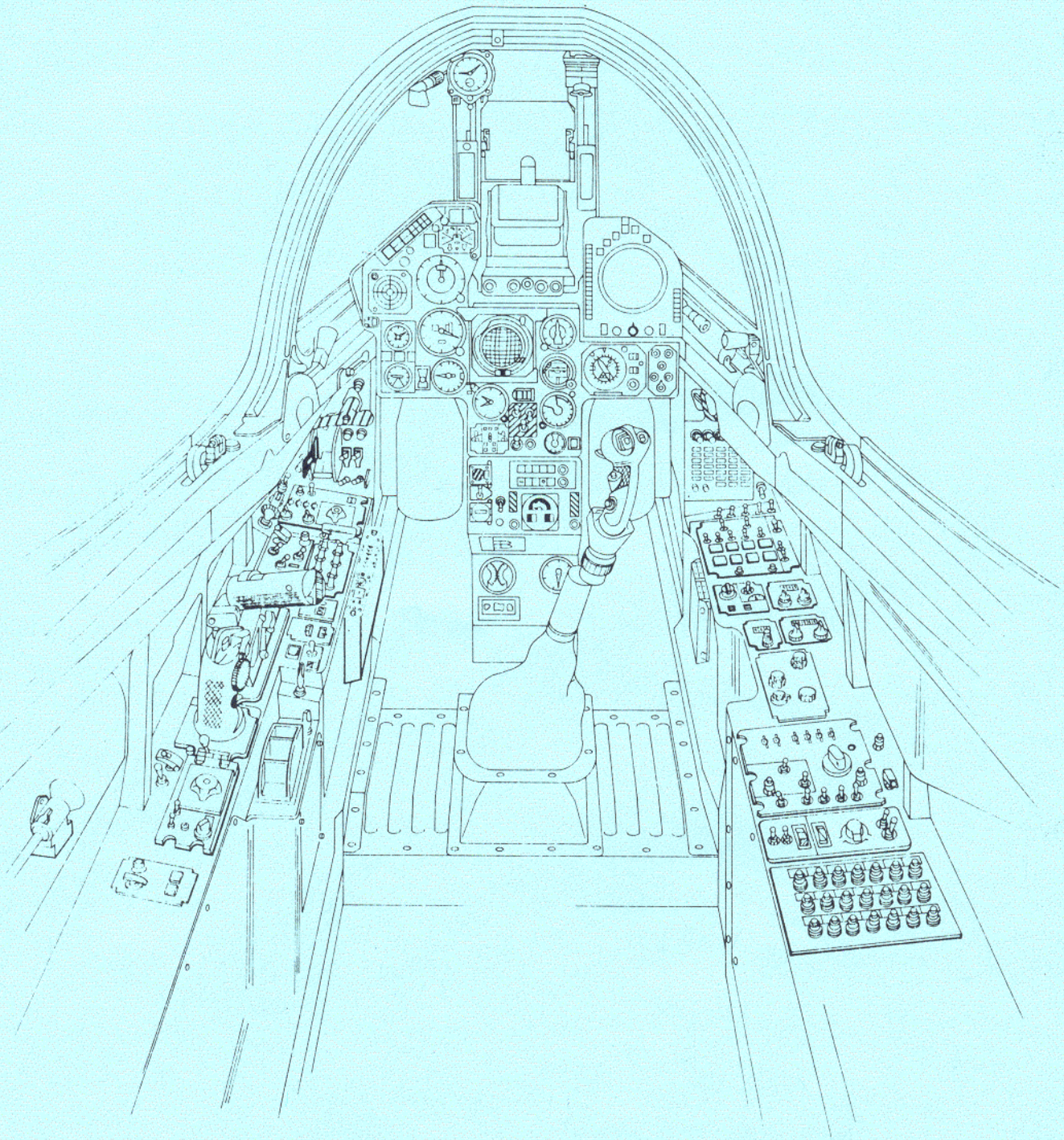
Pressure Reducing Valve

COCKPIT









COCKPIT LAYOUT
(POST/SAAF/MOD/MIR/281,282 and 294)

Section 1

DESCRIPTION - OPERATION

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1,10 – AIRFRAME

1,10 - AIRFRAME

1,10.1 - INTRODUCING THE AIRCRAFT

The MIRAGE F1 CZ, manufactured by AVIONS MARCEL DASSAULT - BREGUET AVIATION, is an air defence aircraft.

Primarily designed for interception and interrogation missions, the aircraft is also capable of AIR-GROUND missions. It is a single seat aircraft characterized by a high, low-aspect ratio, swept-back wing comprising high-lift devices, and by a low stabilator.

The characteristics of the airframe are as follows :

Wing area ..... 25 m2 (269 sq. ft)
Wing loading ..... 385 kg/m2 to 600 kg/m2 (79 to 123 lbs/sq. ft)
Maximum L/D ratio

clean [10] i = 7° IAS
- for W = 10 t (22, 045 lbs) : ~280 kt at 30, 000 ft ; ~270 kt at 10, 000 ft
- for W = 9 t (19, 840 lbs) : ~265 kt at 30, 000 ft ; ~255 kt at 10, 000 ft

with auto slats [8.5] i = 7.5° IAS
- for W = 10 t (22, 045 lbs) : ~265 kt at 30, 000 ft ; ~255 kt at 10, 000 ft
- for W = 9 t (19, 840 lbs) : ~250 kt at 30, 000 ft ; ~245 kt at 10, 000 ft

all down [4.5] (1000 litres (220 Imp. gals - 264 U.S. gals) remaining and W ~ 8.750 t (19, 290 lbs)
i = 9.5° IAS ~ 150 kt at 1500 ft

The aircraft is equipped with a tricycle undercarriage having medium-pressure twin wheels and a steerable nose wheel.

1,10.2 - LOADING CONFIGURATIONS

The aircraft attachment stations permit numerous loading configurations (one multiple underfuselage station and three stations under each wing).
The operational equipment of the aircraft permits :
- all-weather detection, pursuit and air-air attack with missiles or guns
- blind rendez-vous and visual identification
- visual attack of ground targets.

1,10.3 - MAJOR COMPONENTS

The airframe is composed of the following major components :
- THE FUSELAGE, which is of four-spar monocoque construction, and consists of :
  - a forward body comprising : the radar nose cone
    the cockpit
    the aft section (equipment bay and nose wheel well)
  - a main body comprising : the engine and its air intake ducts
    the main aircraft ancillaries
    the two main U/C legs
    the gun bays and their ammunition
    the airbrakes
    the fuel tanks
- THE TWO INDEPENDENT WINGS, which are of single-spar construction, are fitted in high position into the sides of the fuselage, and consist of :
  - a box forming a structural fuel tank
  - a leading edge carrying moving slats
  - a trailing edge carrying flaps and ailerons
  - spoilers on the wing upper surface
- THE FIN , which is of single-spar construction, fitted into the fuselage and having a structural box
  The trailing edge carries the rudder
- THE TWO STABILATOR SURFACES, which are pivoted about shafts fitted into the fuselage.

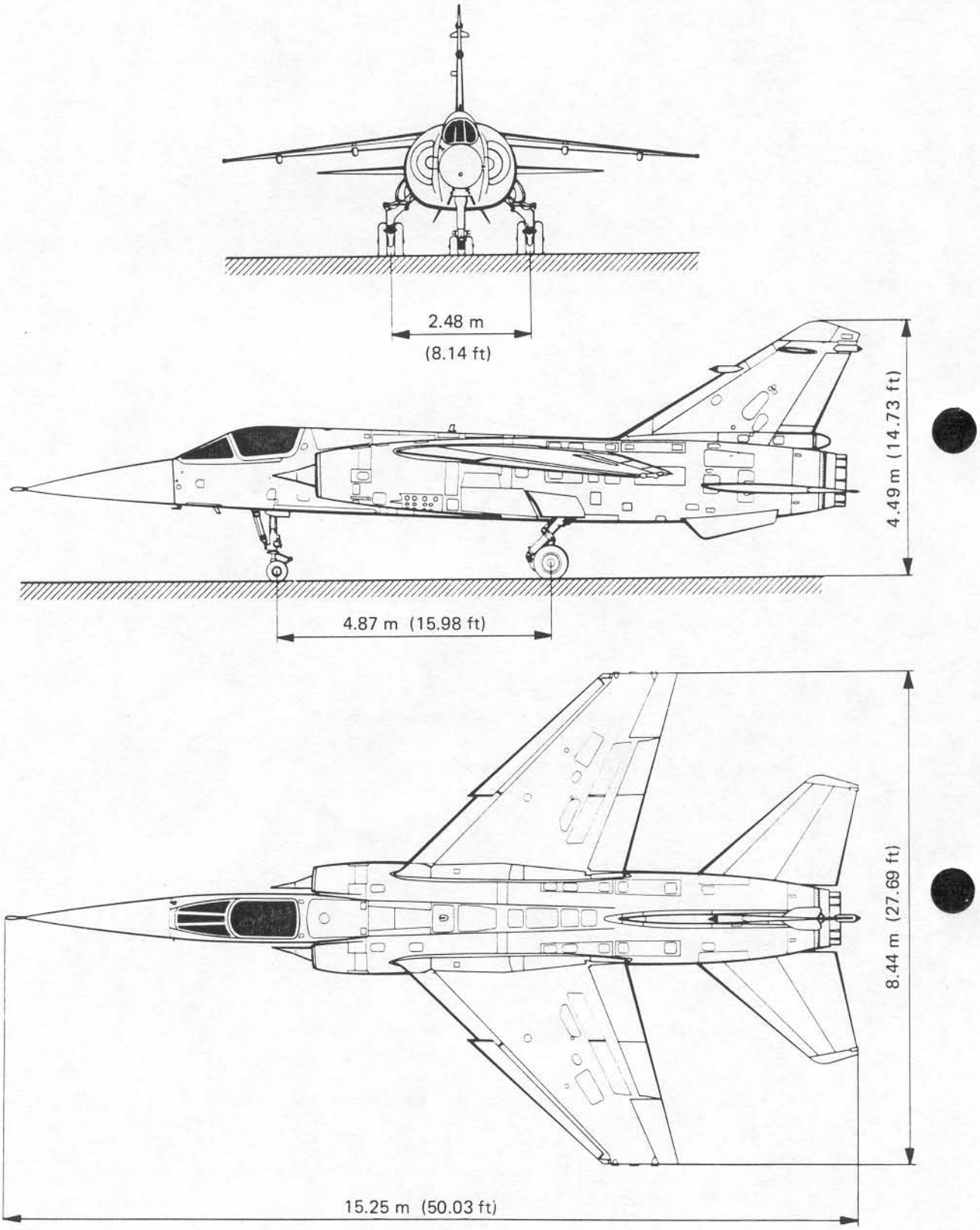
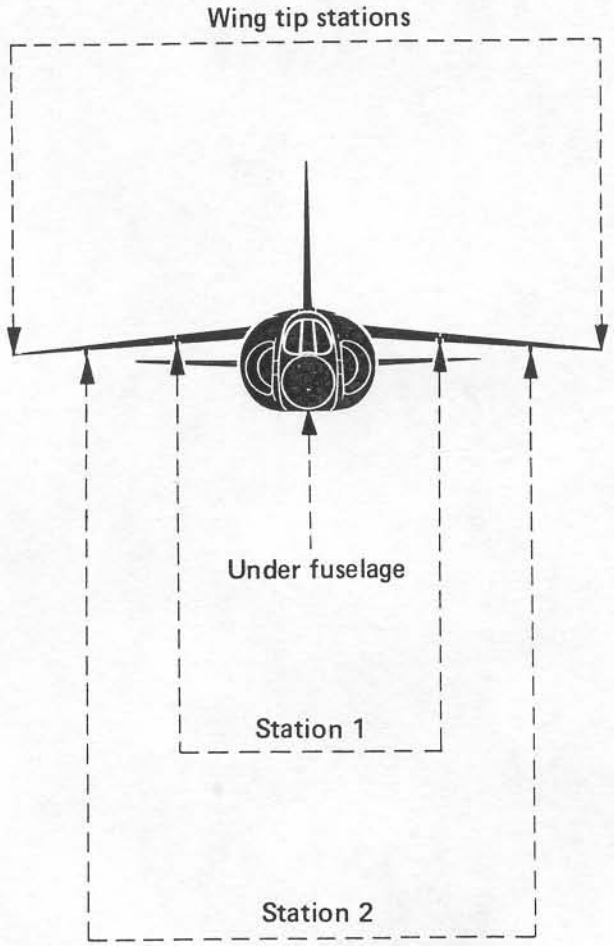


FIGURE 1 - THREE-VIEW DRAWING



Store mounting stations are shown above :

APPROVED LOADINGS AND ASSOCIATED CONFIGURATIONS
ARE DEFINED IN BOOK 3

FIGURE 2 – STORE MOUNTING CAPABILITIES

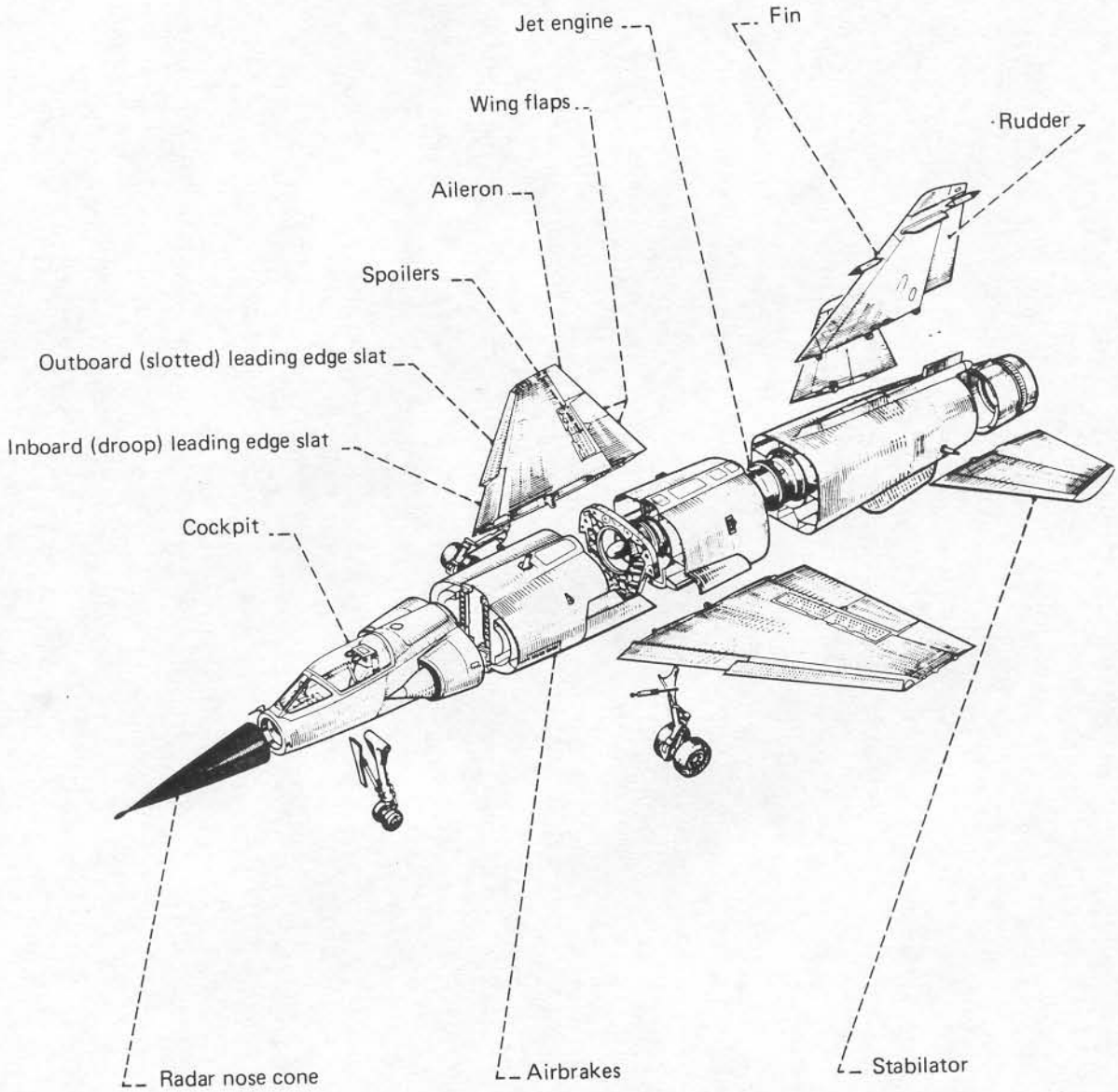
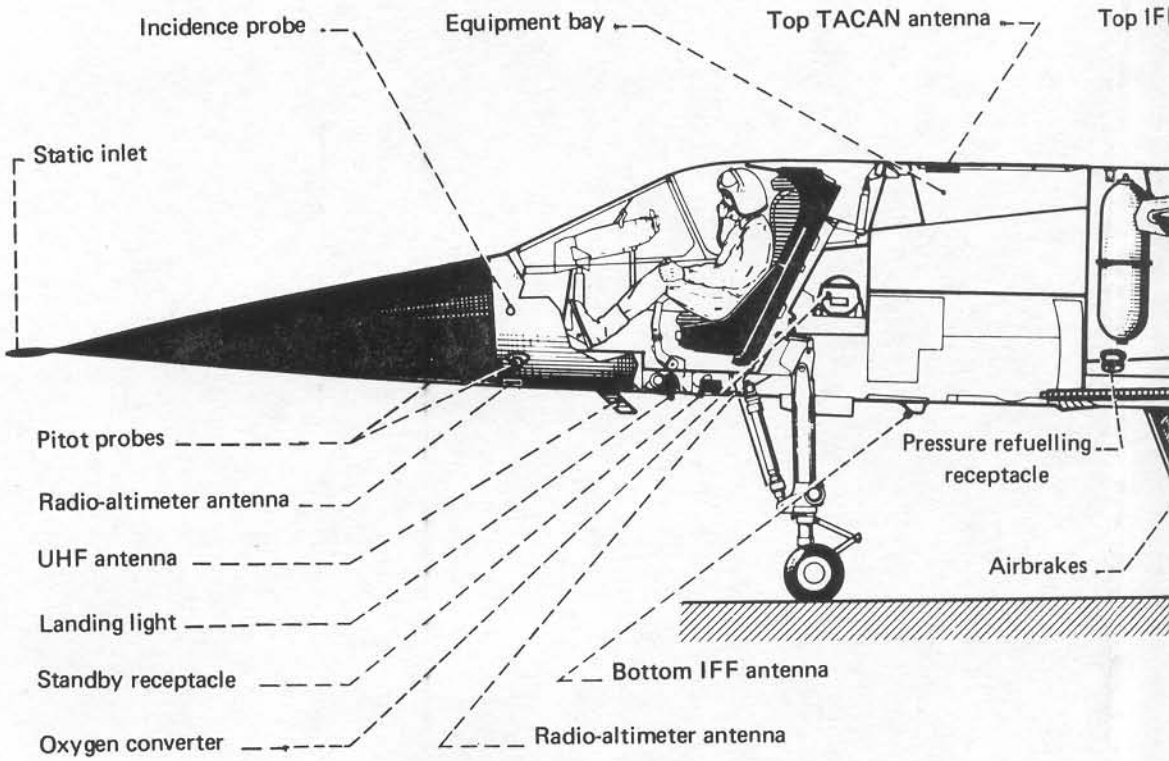


FIGURE 3 - MAJOR COMPONENTS



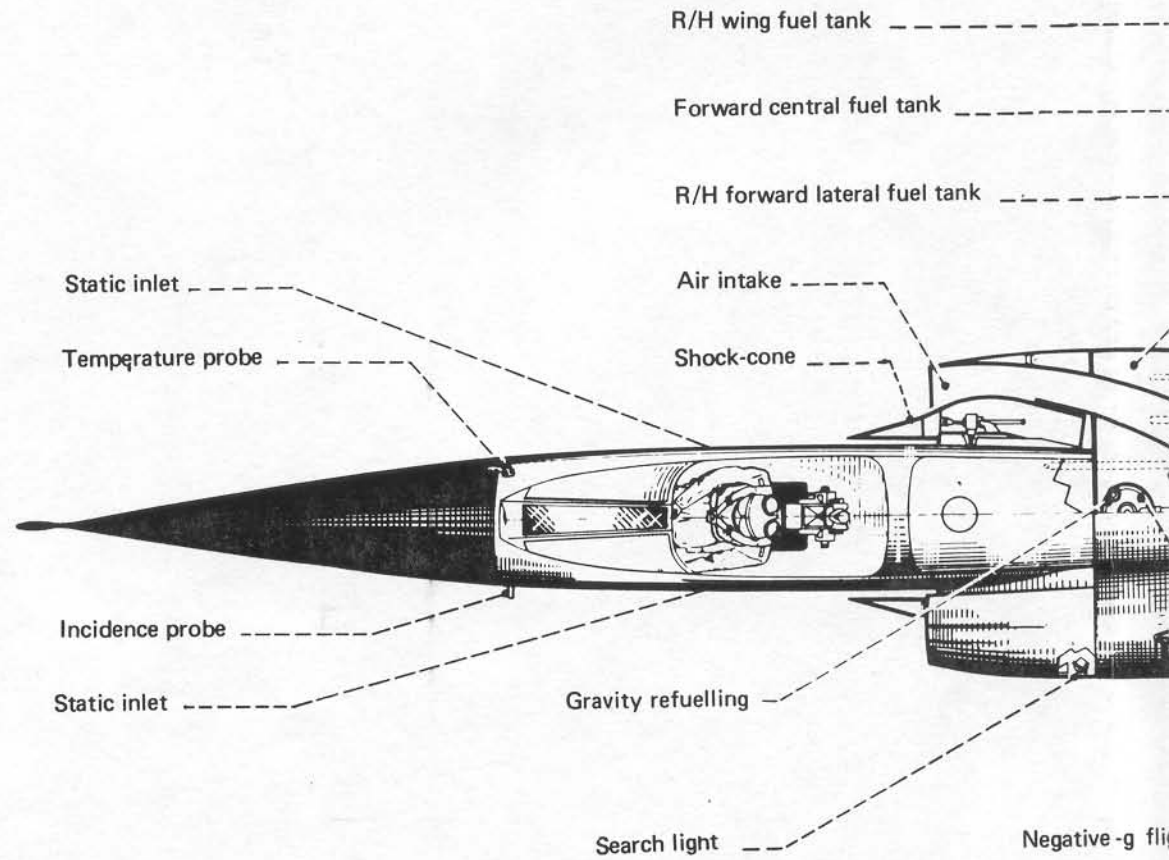
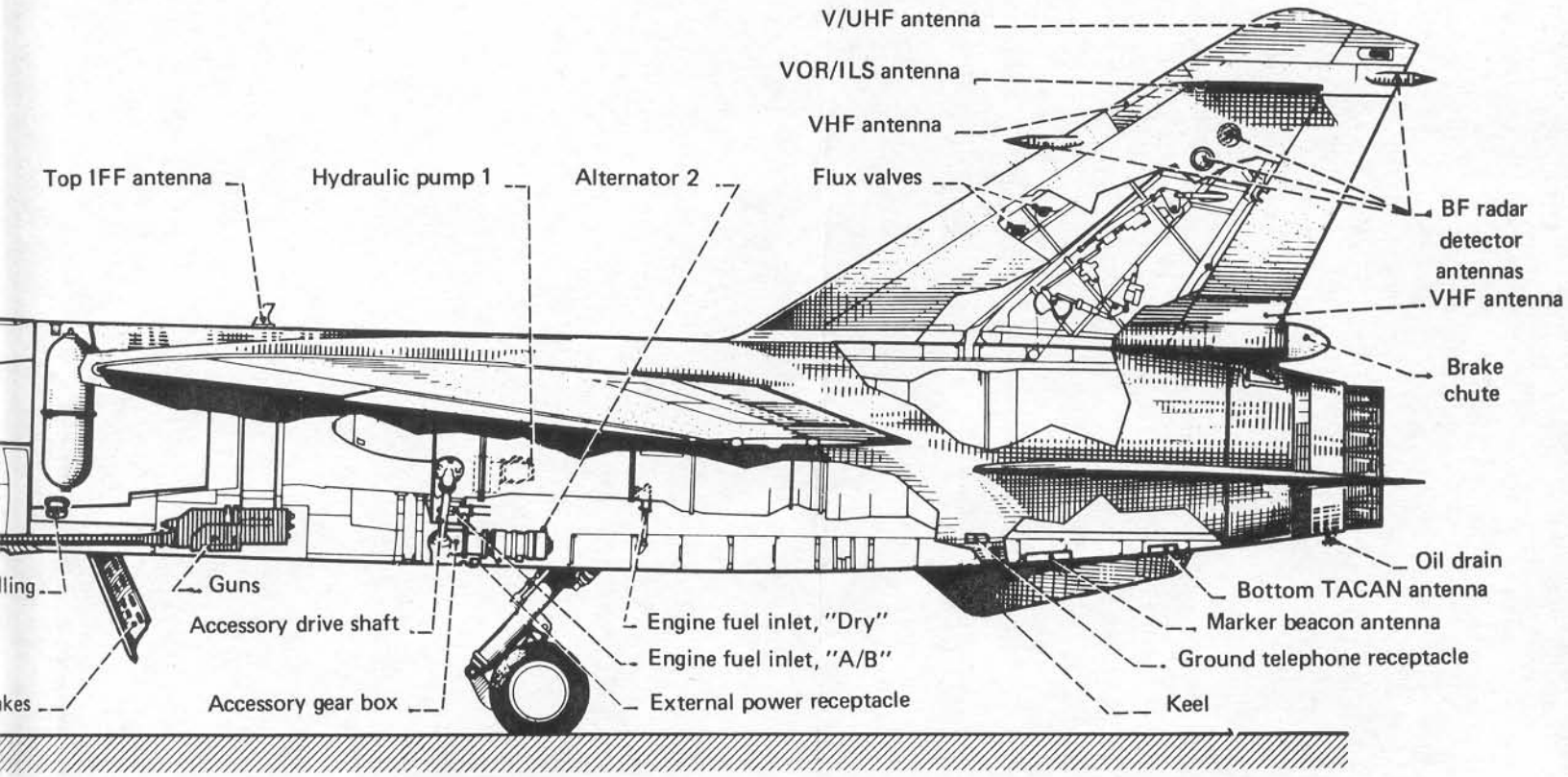
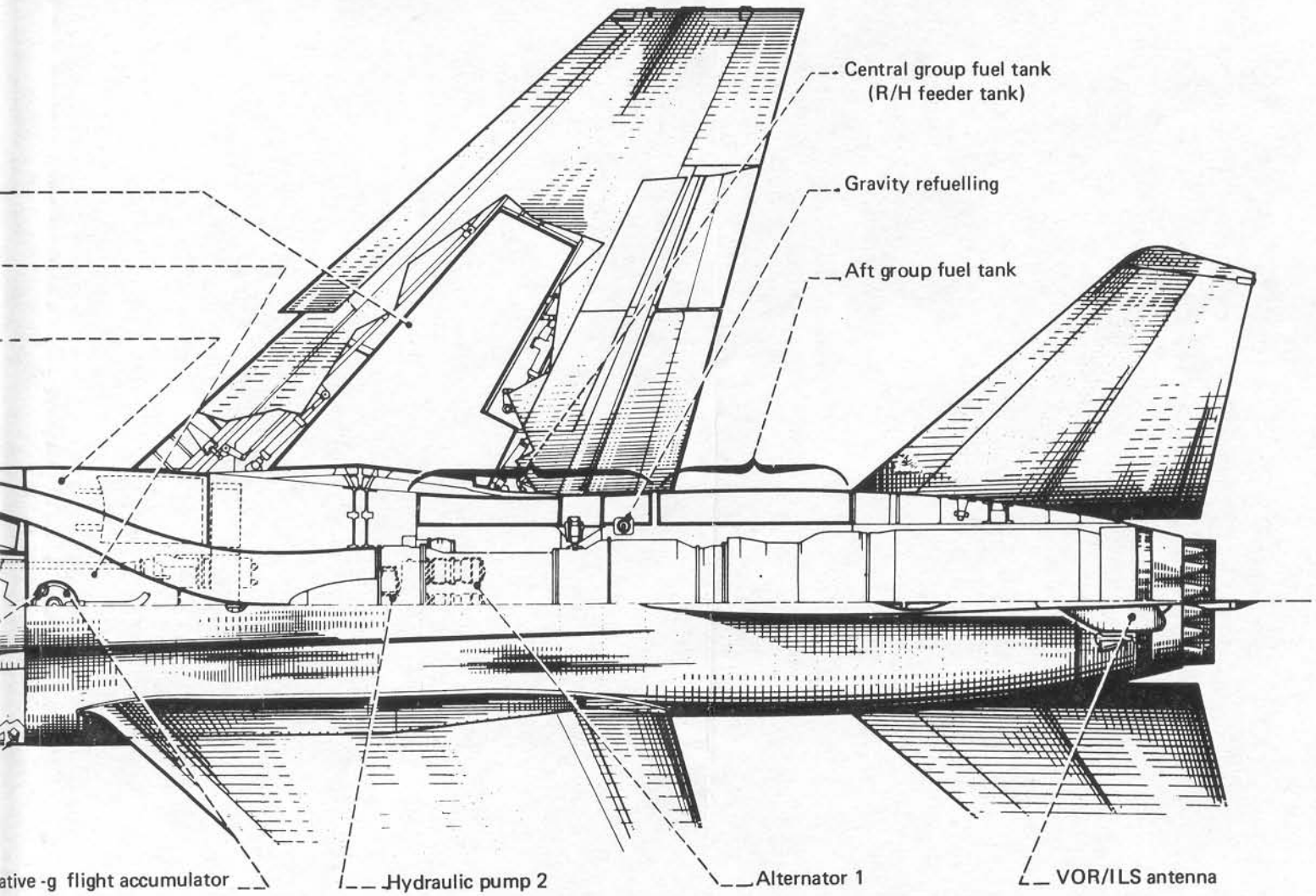


FIGURE 4 - GENERAL LAYOUT


V/UHF antenna
VOR/ILS antenna
VHF antenna
Top IFF antenna
Hydraulic pump 1
Alternator 2
Flux valves
BF radar detector antennas
VHF antenna
Brake chute
Oil drain
Guns
Accessory drive shaft
Engine fuel inlet, "Dry"
Engine fuel inlet, "A/B"
Bottom TACAN antenna
Marker beacon antenna
Ground telephone receptacle
Accessory gear box
External power receptacle
Keel


Central group fuel tank (R/H feeder tank)
Gravity refuelling
Aft group fuel tank
Hydraulic pump 2
Alternator 1
VOR/ILS antenna

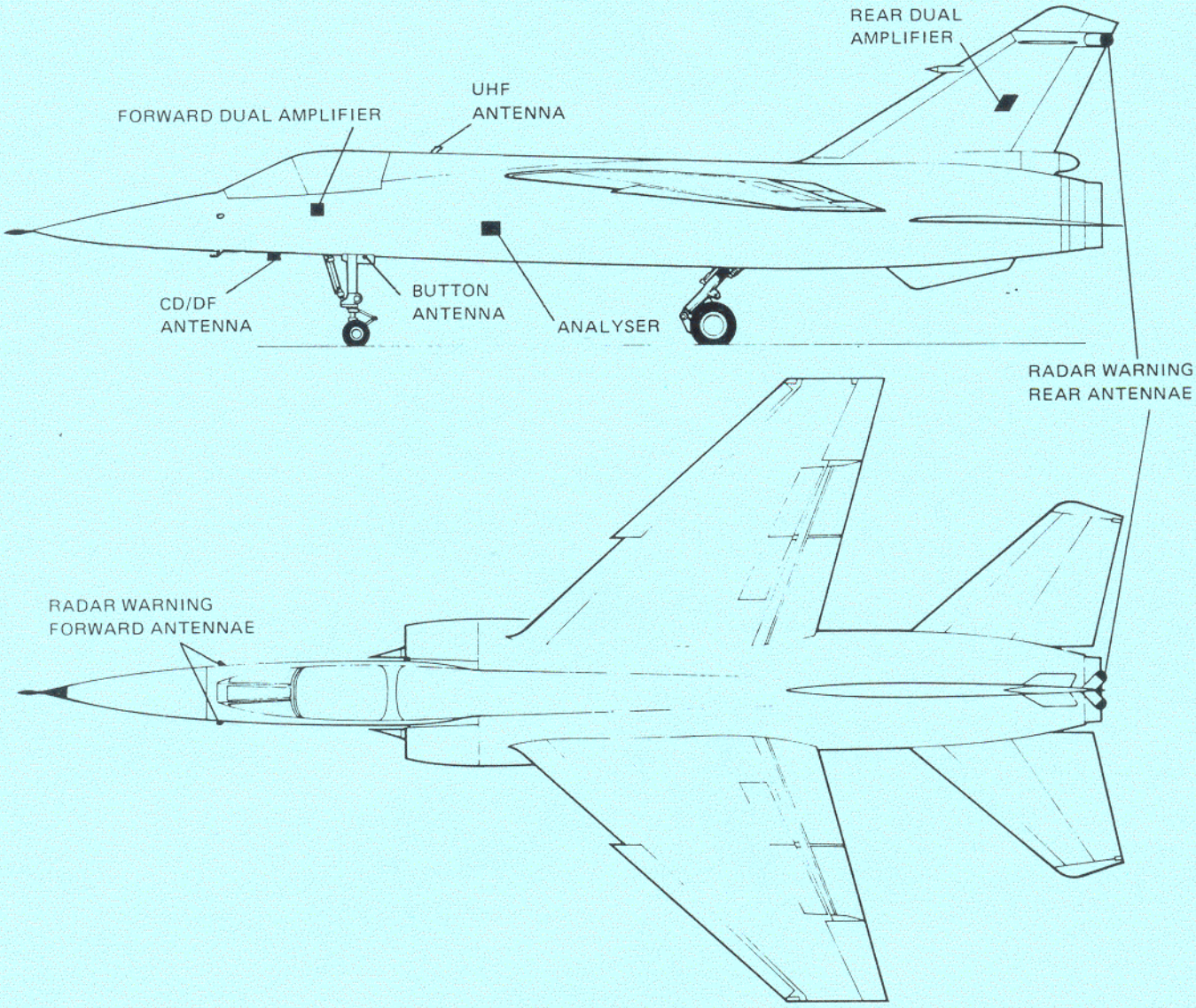


FIGURE 4A-GENERAL LAYOUT RADAR WARNING SYSTEM
(POST/SAAF/MOD/MIR/282)

1,15 – ELECTRICAL SYSTEM

1, 15 - ELECTRICAL SYSTEM

1, 15.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
BATTERY	Battery switch	2 positions	
	BATT light	Red	
ALTERNATOR 1	Alternator switch	2 positions	
	ALT.1 light	Amber	
ALTERNATOR 2	Alternator switch	2 positions	
	ALT.2 light	Amber	
	MODUL light	Red	
TRANSFORMER-RECTIFIERS	TR reset button		1 only for both TR's
	TR.1 TR.2 lights	Amber	1 light for each TR
INVERTER	Inverter selector switch	3 positions "INV" } steady positions "AUTO" } "RESET" spring-loaded position	
	EMG~ light	Amber	
	Control circuit-breaker	"INV. CONT"	See Figure 1
	Power circuit-breaker	"INV. POW"	See Figure 1

1,15.2 - DESCRIPTION

The aircraft electrical power is produced by :

- Two alternators, three-phase, 400 Hz, 115/200 V AC, 15 kVA, installed on the accessory gearbox ; they include an electromechanical device whose output rotates at constant speed and whose mechanical part is a two-speed gearbox provided with automatic change of gears at about 5200 ± 50 rpm during engine acceleration or deceleration.
  Each alternator supplies a power system.
- Two 100 A transformer-rectifiers, each supplying the necessary power for the 28 V DC system.
- One 40 Ah battery connected as a buffer battery in the DC system.

In addition :

A switching box enables an emergency AC system to be supplied either by the alternators or by the DC system through a static inverter.

A standby receptacle enables certain equipment items to be energized and preheated on the ground.

An external AC power receptacle enables the systems to be supplied from an auxiliary power unit.

The power distribution mainly comprises four systems :

- AC system 1, which is normally supplied by alternator 1.
- AC system 2, which is normally supplied by alternator 2.
- The emergency AC system, which is normally supplied by alternator 1.
- The DC system, which is normally supplied by the transformer-rectifiers and the buffer battery, and comprises :
  - a direct battery system
  - a main system
  - a utility subsystem, with automatic load shedding in case of failure of both alternators.

1,15.3 - OPERATION

The quality of the current supplied by the alternators is permanently monitored for voltage and frequency by protection boxes which isolate the defective alternator and transfer its load to the other alternator.
The remaining alternator then supplies both systems.
After starting, the alternators cut in only when they have reached their frequency and voltage thresholds (at approximately 2800 engine rpm). It is recommended to avoid engine rpm between 5500 and 6000 (alternator gear change).
A three-phase static switching box detects any lack of current in system 1 and instantaneously switches the emergency AC system power supply to the inverter.

1 - STARTING

As the alternators have not yet cut in, the emergency AC system is supplied by the inverter and the EMG.~ light is on.

After the engine is started and the alternators have cut in, the inverter selector is set to «RESET» and instantaneously switches the emergency AC system power supply to system 1. The EMG.~ light goes out.

A - When the standby receptacle is connected, the battery and the distribution systems are isolated.
The switches are all turned on ; only the preheated utility systems are supplied.
On the starting signal, cranking and ignition of the engine are electrically accomplished on the battery.
As soon as the alternators cut in, the standby receptacle is automatically disconnected and the aircraft is supplied normally.

B - When the external power receptacle is connected, the alternators are isolated (battery switch "ON" ; light is out) and the two AC systems are supplied.
It should be noted that :
- The external power receptacle has priority over the alternators.
- As the aircraft is equipped with transformer-rectifiers, there is no external DC power receptacle.
- When the engine starts, the BATT light comes on (the battery is isolated).

2 - RESETTING

The «BATT» and «ALT» switches and the «INV» selector are used to reset the equipment items concerned in case of tripping-out.
The "TR" button is used to reset the transformer-rectifiers.

Resetting is performed as follows :

- for the battery and the alternators : turn the corresponding switches («BATT», «ALT.1» or «ALT.2») «OFF», then back «ON»
- for the transformer-rectifier : depress the «TR» button
- for the inverter : set the «INV» selector to «RESET», then back to «AUTO».

Several attempts may be necessary (See para. 4,15, SECTION 4).
The lights on the failure warning panel go out as soon as resetting is effective.

1,15.4 - FAILURES

BATT light on + warning horn

The battery is disconnected from the main system, but can continue to supply its own bus.
When the battery is exhausted, the inflight relight system is inoperative.
If the failure is followed by :

- the failure of both transformer-rectifiers : there is no more DC power
- or the failure of both alternators : there is a complete electrical failure.

ALT.1 light on : EMG~ light may come on

Alternator 1 no longer supplies its system.
Alternator 2 takes over the supply of AC systems 1 and 2.
The emergency system is automatically supplied by the inverter.

ALT.2 light on

Alternator 2 no longer supplies its system.
Alternator 1 takes over the supply of AC systems 1 and 2.

ALT.1 + ALT.2 lights on : EMG~ light also comes on, as well as TR.1 TR.2 lights as soon as battery voltage drops < 25 volts
Both alternators no longer supply their systems.
The emergency system is automatically supplied by the inverter.
Automatic load shedding occurs in the utility DC subsystem.
The only source of electrical power is the battery, which has an endurance of at least 13 min with the electric pump not running.

EMG~ light on

The emergency AC system is supplied by the inverter.

TR.1 or TR.2 light on

Only the transformer-rectifier whose light is out is capable of supplying the DC systems.

TR.1 + TR.2 lights on

Both transformer-rectifiers no longer supply the DC systems.
The only source of DC power is the battery.

MODUL light on + warning horn

Continuous illumination of this light indicates to the pilot excessive modulations of the vario-alternator driving torque with the risk of damage to their drive as the result of mechanical resonance of one vario-alternator in relation to the other.
The mechanical coupling will be broken by the switch-off of an alternator ; the persistent warning thus only indicates a failure in the electronics associated with the light.

COMPLETE ELECTRICAL FAILURE : All lights are out.

This failure results from the exhaustion of the battery (< 18 volts) or the complete failure of the alternators and reverse-current relay.

The following remain available to the pilot :

- clock
- RPM indicator
- standby compass
- standby altimeter, Mach/airspeed indicator, vertical speed indicator
- accelerometer
- canopy embrittle and seat ejection systems
- brake chute
- brakes (without antiskid system)

Emergency procedure must be applied to extend the U/C (no electrical sequence).

Fuel transfer takes place normally. The engine is supplied by gravity.

The slats and flaps are inoperative.

The flight controls operate in mechanical mode.

The ARTHUR goes into low mode.

The shock cones are immobilized in the position existing at the time of failure.

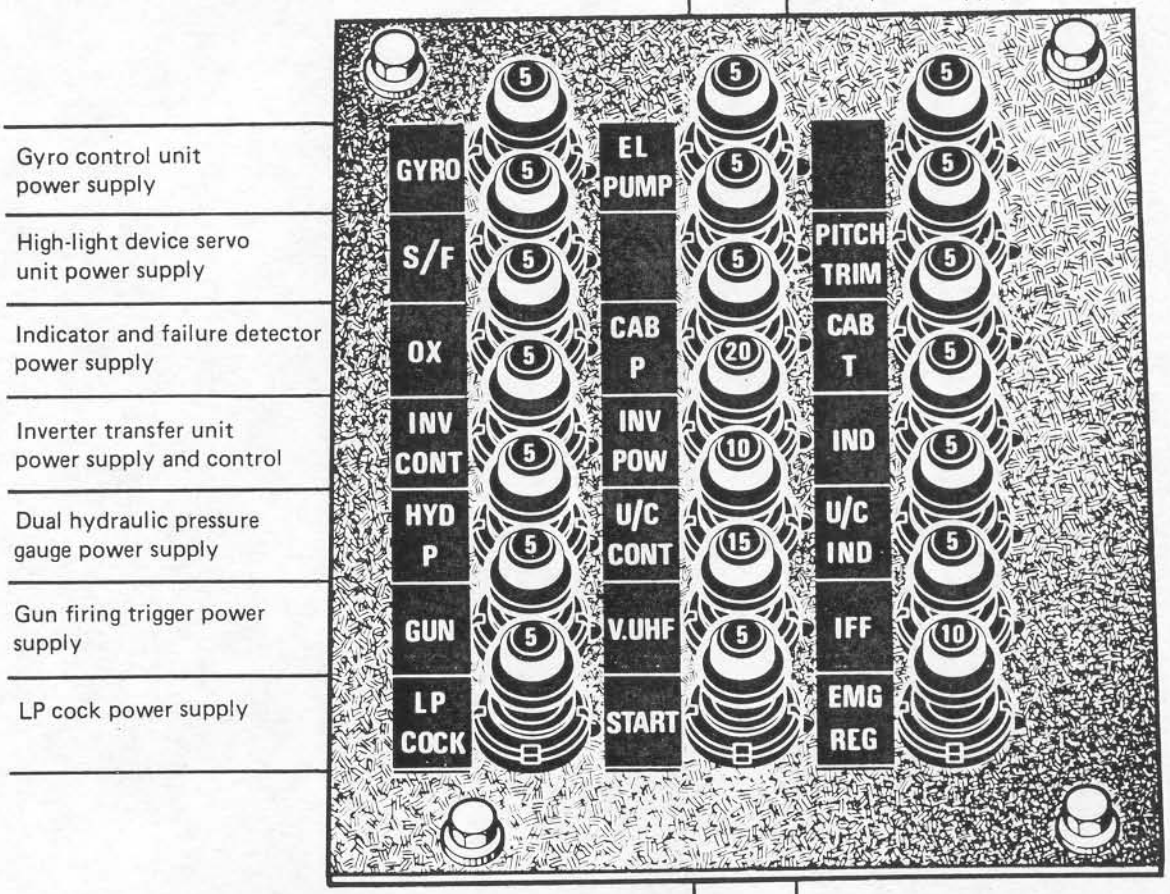


FIGURE 1 - CIRCUIT-BREAKER BOX

AC SYSTEM 2

RIMS
L/H and R/H LP pumps
Radar
TV815 amplifier (JPT regulation)
UV Lights
Radar Warning
Cabin temperature
Equipment temperature
Oxygen
Anti-skid system
Integral lighting
Landing/Taxi/
Search light transformer
Harmonization unit

BATTERY SYSTEM

Starter
Ignition coil
Starting unit
Ignition switch
Battery control
External power receptacle control
Emergency jettison
Radar control
Lead light
Selective and 550 missile jettisoning
Standby receptacle door actuator
Ground telephone amplifier 2
Role change test

MAIN DC SYSTEM

Fuel gauges
TV815 amplifier
Weapon safety
Navigation indicator
Emergency transfer
Emergency nose wheel steering
Incidence probe heating
In-flight relight control
Auto retraction
2nd interlock
Slat operation
Transfer switching
Starting pump
Lighting
Alternator 1 control
Alternator 2 control
(a) LP cock
Preheating relay control
(a) Starting control
Secondary (red) V/UHF
Nose wheel steering power supply
Shock-cones
Nose wheel steering control-
Search light (flight)

Rudder trim
Roll trim
Trim indicator
Overspeed
L/H pitot probe heating
Transfer control
Slat indicating
Emergency gyro control
U/C anti-retraction system
Flying aid channel 1
Flying aid channel 2
Incidence - Probe power supply
Warning
Stick uncoupling
Anti-slip system
Equipment temperature
Warning test
Fire detection
Crossfeed
Fuel remaining indicator
Fuel transfer indicator

R/H LP pump control
L/H LP pump control
High-lift device emergency retraction
A/B
JPT solenoid valve
Inverter
Deicing
Static pressure probe heating
Radio-altimeter
Omnibearing selector
Pitch auto-trim
Rockets - Bombs
Guns
Warning horn
Landing/Taxi light control
Roll auto-trim
Electro-pump power supply
Automatic load-shedding
Battery interlock
RIMS

(a) IFF
(a) Hydraulic pressure
(a) Electro-pump control
(a) Emergency regulation
(a) U/C control
(a) U/C indicating
(a) Warning
(a) Inverter control
(a) Inverter power
(a) Oxygen
(a) Cabin pressure
(a) Air conditioning
(a) Gyro control
(a) Main (green) V/UHF
(a) Firing trigger
(a) Slat control
(a) Pitch trim
Standby receptacle door actuator
Intensity adjustment unit
Airbrakes
Hydraulic shut-off
Seat adjustment
Ground telephone amplifier 1

(a) CIRCUIT-BREAKERS ACCESSIBLE TO PILOT

ANCILLARY DC SUB-SYSTEM

550 missile control
Missile safety
Autopilot
TACAN
Harmonization unit
Active Countermeasures

Radar
Sight
Navigation Lights
Formation Lights
VOR/ILS
Gyro centre
Radar warning

FIGURE 2A – ELECTRICAL POWER GENERATION AND DISTRIBUTION SYSTEM
(POST/SAAF/MOD/MIR/281, 282, 294)

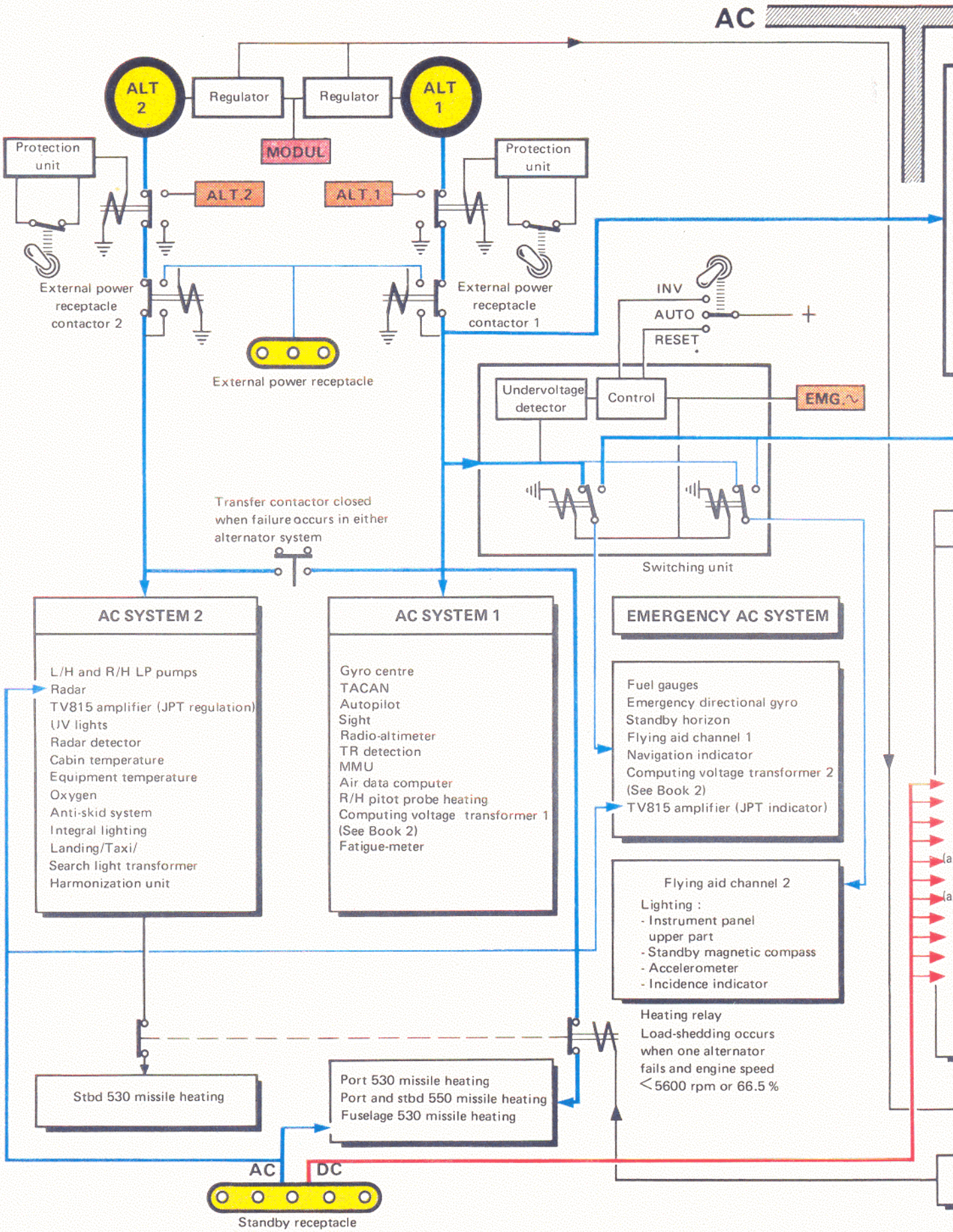
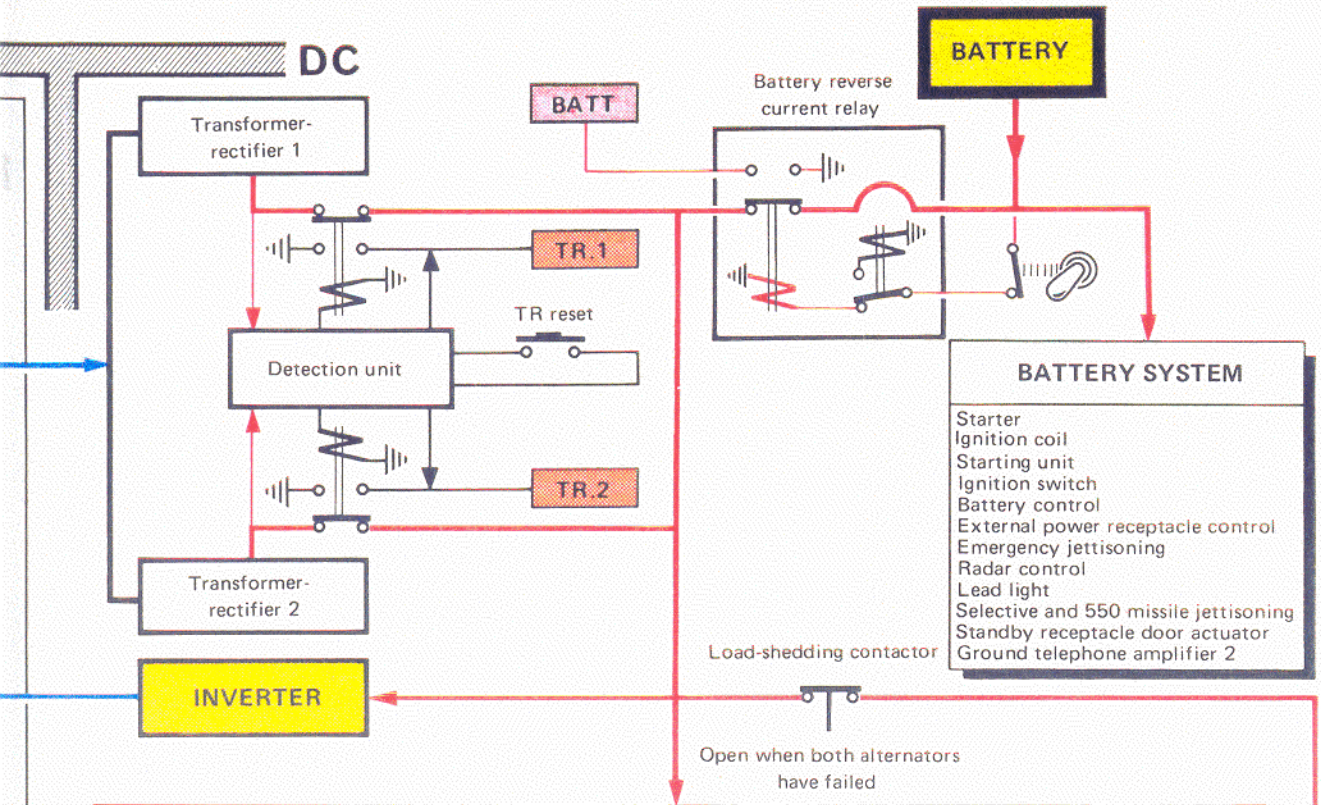


FIGURE 2 - ELECTRICAL POWER GENERATION AND DISTRIBUTION SYSTEM



MAIN DC SYSTEM

- Fuel gauges
- TV815 amplifier
- Weapon safety
- Navigation indicator
- Emergency transfer
- Emergency nose wheel steering
- Incidence probe heating
- In-flight relight control
- Auto retraction
- 2nd interlock
- Slat operation
- Transfer switching
- Starting pump
- Lighting
- Alternator 1 control
- Alternator 2 control
- (a) LP cock
- Preheating relay control
- (a) Starting control
- Secondary (red) V/UHF
- Nose wheel steering power supply
- Shock-cones
- Nose wheel steering control - Search light (flight)
- Rudder trim
- Roll trim
- Trim indicator
- Overspeed
- L/H pitot probe heating
- Transfer control
- Slat indicating
- Emergency gyro control
- U/C anti-retraction system
- Flying aid channel 1
- Flying aid channel 2
- Incidence - Probe power supply
- Warning
- Stick uncoupling
- Anti-slip system
- Equipment temperature
- Warning test
- Fire detection
- Crossfeed
- Fuel remaining indicator
- Fuel transfer indicator
- R/H LP pump control
- L/H LP pump control
- High-lift device emergency retraction
- A/B
- JPT solenoid valve
- Inverter
- Deicing
- Static pressure probe heating
- Radio-altimeter
- Omnibearing selector
- Pitch auto-trim
- Rockets - Bombs
- Guns
- Warning horn
- Landing/Taxi light control
- Roll auto-trim
- Electro-pump power supply
- Automatic load-shedding
- Battery interlock
- (a) IFF
- (a) Hydraulic pressure
- (a) Electro-pump control
- (a) Emergency regulation
- (a) U/C control
- (a) U/C indicating
- (a) Warning
- (a) Inverter control
- (a) Inverter power
- (a) Oxygen
- (a) Cabin pressure
- (a) Air conditioning
- (a) Gyro control
- (a) Main (green) V/UHF
- (a) Firing trigger
- (a) Slat control
- (a) Pitch trim
- Standby receptacle door actuator
- Intensity adjustment unit
- Airbrakes
- Hydraulic shut-off
- Seat adjustment
- Ground telephone amplifier 1

(a) CIRCUIT-BREAKERS ACCESSIBLE TO PILOT

Low speed load-shedding relay control

ANCILLARY DC SUB-SYSTEM

530 missile heating control
550 missile heating control

550 missile firing
550 missile selection
530 missile control (selection)

Low speed load-shedding relay
Load-shedding occurs when one alternator fails and engine speed < 5600 rpm or 66.5 %

- 550 missile control
- Missile safety
- Autopilot
- TACAN
- Harmonization unit
- Radar
- Sight
- Navigation lights
- Formation light
- VOR/ILS
- Gyro centre
- Radar detector

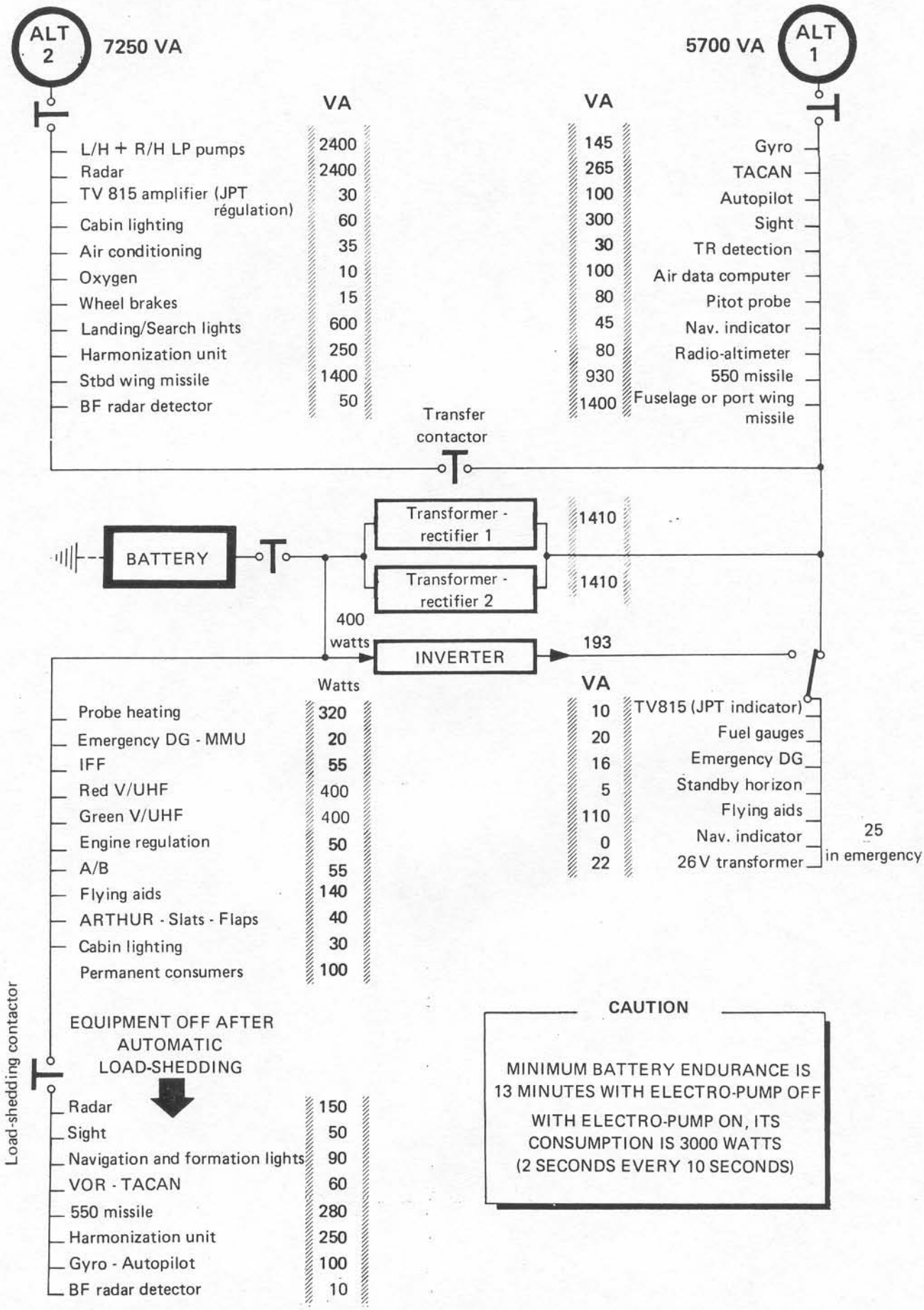


FIGURE 3 - ELECTRICAL LOAD BREAKDOWN

FIGURE 4 – ELECTRICAL SYSTEM
CONTROLS AND INDICATORS

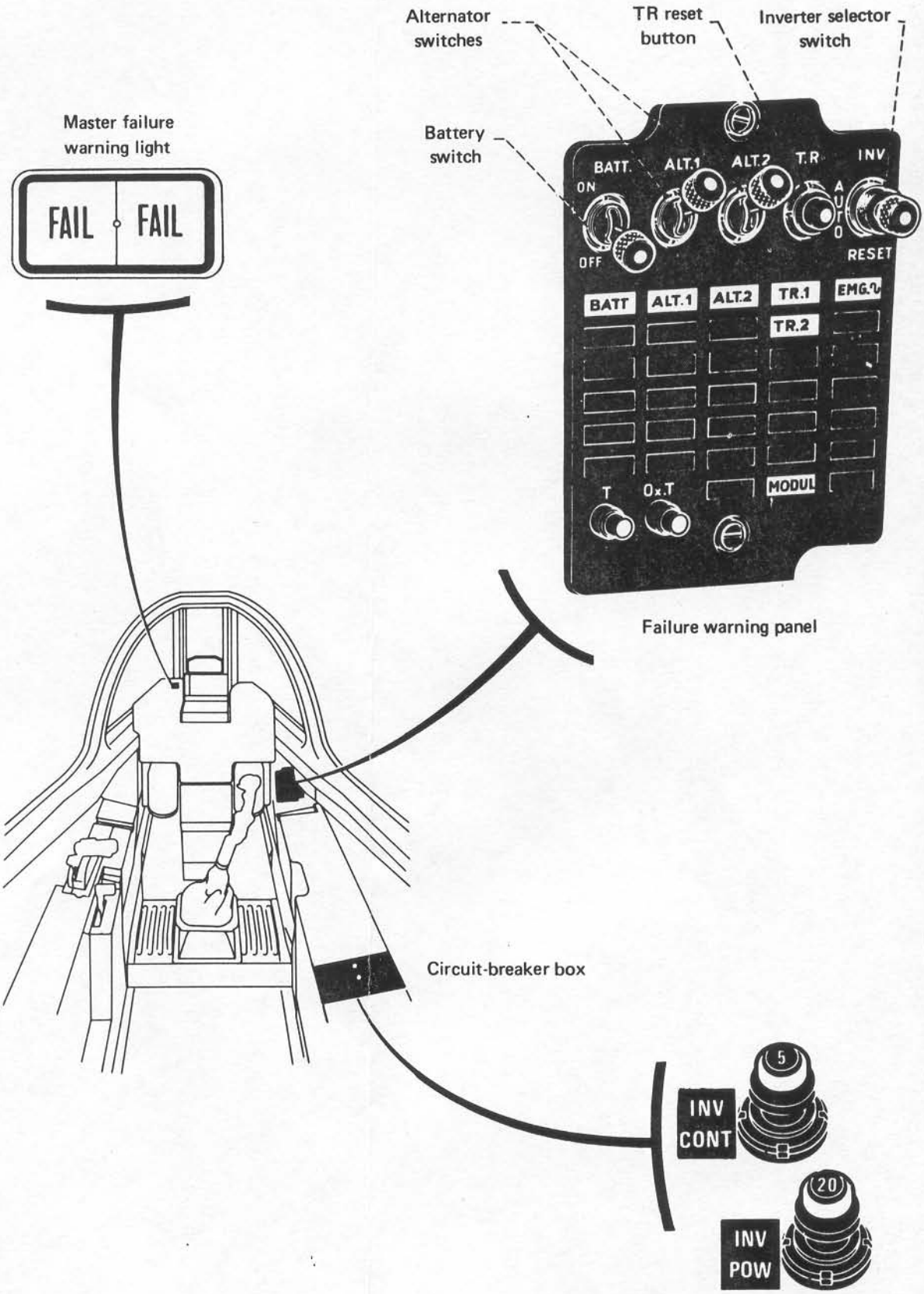


FIGURE 4 - ELECTRICAL SYSTEM CONTROLS AND INDICATORS

1,20 – FUEL SYSTEM

1,20 - FUEL SYSTEM

1,20.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
SUPPLY	LP main cock switch	2 positions Guarded	
	LP cock circuit breaker	"LP COCK"	
	AB main cock switch	2 positions Guarded	
	LP. light	Red	
	Starting pump switch	2 positions Switched by starter button guard	See Engine Section
	LH LP pump switch	2 positions	
	L/H LP light	Amber	
	RH LP pump switch	2 positions	
	R/H LP light	Amber	
TRANSFER	Fuel transfer indicator	Representation of tanks	Testable
	Fuel remaining indicator	4-figure counter	Value in liters
	Dual fuel gage	2 pointers	Value in liters
	Fuel gage test button		- Depressing button causes pointers to turn CCW as long as pressure is applied - As button is released, pointers return to initial position
	Feeder tank/Fuselage selector	2 positions	
	500 L. light	Amber	
	Fuel transfer sequence selector switch	2 positions Switch mounted on striped background placard	
	Crossfeed switch	2 positions on striped background	
	Emergency fuel transfer switch	2 positions - Lockable switch on striped background placard	
JETTISONING	Selective jettison button	Recessed under guard	
	Jettisoning selector	3 positions "WING" - (2) (1) "FUS"	"WING" : not applicable (1) : jettisoning of station 1 pylon tanks "FUS" : jettisoning of underfuselage pylon tank
	Emergency jettison button	Recessed under striped guard	

1, 20. 2 - DESCRIPTION

The tanks, the fuel system and the engine are designed to use TR0 (JP1) and TR4 (JP4) fuel. (See Note)
The aircraft fuel system comprises a R/H system and a L/H system, which are normally isolated from each other by a crossfeed cock.
All the fuselage and wing tanks are structural tanks.

The fuselage tanks are divided into three groups :
- forward group
- central group, forming the feeder tanks
- aft group.

The aircraft can also carry three 1200-litre (264 Imp. gal - 317 U. S. gal) pylon tanks (1155 l - 254 Imp.gals - 305 U. S. gals of usable fuel).
Refuelling is normally carried out under pressure at a single point. Emergency refuelling of the fuselage tanks is effected by gravity (two ports).
The various groups of tanks and the pylon tanks are transferred into the feeder tanks by pressure of the air bled from the engine compressor.
Theoretically, fuel level drop is identical in the R/H and L/H systems.
The engine fuel supply is provided by two electric LP pumps (AC) installed at the bottom point of the feeder tanks.
Another electric LP pump (DC) is used for starting and in-flight relight.
This pump cuts out automatically when the R/H LP pump is energized.
A negative-g flight accumulator, located in the forward central tank, provides the engine with a supply of approximately 15 seconds at full power dry.

Capacities

Forward group (L/H lateral : 545 l (120 Imp. gals - 144 U. S. gals), central : 585 (129 Imp. gals - 155 U. S. gals), R/H lateral : 545 l (120 Imp. gals - 144 U. S. gals))	1675 l (368 Imp. gals - 442 U. S. gals)
Feeder tanks (L/H and R/H) 2 x 532. 5 l (117 Imp. gals - 141 U. S. gals) .	1065 l (234 Imp. gals - 281 U. S. gals)
Aft group (L/H and R/H) 2 x 560 l (123 Imp. gals - 148 U. S. gals)	1120 l (246 Imp. gals - 296 U. S. gals)
Wing tanks (L/H and R/H, ungauged) 2 x 190 l (42 Imp. gals - 50 U. S. gals)	380 l (84 Imp. gals - 100 U. S. gals)
Negative-g flight accumulator (ungauged) 60 l (13 Imp. gals - 16 U. S. gals)	60 l (13 Imp. gals - 16 U. S. gals)
Total, Internal	4300 l (945 Imp. gals - 1135 U.S. gals)

This total represents the usable capacity of the tanks and corresponds to a refuelling with the use of the forward and aft tank topping-up buttons, which enable the capacity to be increased by 60 litres (13 Imp. gals - 16 U. S. gals).
Without the use of these buttons, there are 4240 litres (933 Imp. gals - 1120 U. S. gals) usable (figure retained for normal use).

A dual fuel gauge indicates the fuel quantity contained :
- in the L/H and R/H fuselage tanks, or
- in the L/H and R/H feeder tanks only

according to the position of the "F-FT" (fuselage-feeder tank) selector switch.

A fuel remaining indicator subtracts from the total fuel quantity (preset before engine start) the amount of fuel which is consumed by the engine (dry or A/B operation). Therefore, it gives at all times the total quantity of remaining fuel.
It can be reset in flight in case of pylon tank jettisoning.
Its power supply comes from the main DC system.

NOTE : Change in fuel grade affects an adjustable parameter : fuel density.
Density : When changing fuel grade, it is necessary to adjust the density correctors (on the main FCU and on the A/B FCU) in order to restore original engine performance. Failing to alter the density corrector settings would result in slightly reduced performance, specially at intermediate engine speeds.
Starting injection pressure : The starting injection pressure being the same ($1.1 \,^{+0.2}_{-0.1}$ bar ($16 \,^{+2.9}_{-1.4}$ psi)), whichever fuel is used (TR0 or TR4) (JP1 or JP4), the in-flight relight envelope also remains the same.

1,20.3 - OPERATION

1- ENGINE SUPPLY

The pumps supply the engine through a common supply line to which the negative-G flight accumulator is connected in parallel.

An LP main cock enables the LP fuel supply to the engine and the afterburner to be shut off.

An AB main cock enables the fuel supply to the afterburner only to be shut off.

2- FUEL TRANSFER

Fuel transfer is fully automatic.
The transfer sequence is monitored on the fuel transfer indicator.
The fuel transfer indicator consists of an aircraft outline with the fuel tanks represented by indicator lights. When a fuel tank is empty, the associated indicator light comes on. Electrical power for the fuel transfer indicator comes from the main DC system. The fuel transfer indicator is provided with a test button. Whenever a pylon tank is not fitted, the associated indicator light is out.

Two fuselage tank transfer sequences are possible. They enable variations of the aircraft center of gravity to be reduced according to the configuration (clean or with pylon tanks).

The tank selection (1, 2, 3, 4, 5 or 1, 3, 2, 5, 4) is made by means of a selector switch controlling a selector valve slaved to the LP fuel pressure.

NOTE : Whenever one or several pylon tanks are carried, full or empty, set the fuel transfer sequence selector switch to «WG. PYL. TK».

The pylon tanks are transferred first.

The levels in the feeder tanks are maintained constant during transfer by valves slaved to floats.

Self-sealing air valves, located at the bottom of each tank, close the corresponding transfer lines as soon as the tank is empty ; the corresponding end-of-transfer light comes on (due to lack of pressure).
For tank 3 and for the pylon tanks, the light is illuminated by a float switch.

An emergency transfer system enables transfer by gravity, if required, of the aft lateral tanks to the feeder tanks. Transfer takes place when the emergency fuel transfer switch is on ; the LP fuel pressure then acts on slaved valves which allow the fuel to be transferred.

A crossfeed valve permits interconnection of the two feeder tanks.

REMARK :
- As the crossfeed system balances the feeder tanks only, the «CROSSFEED» valve must be used only in case of large asymmetry read on the fuel gages in «FT» position (Usually, this asymmetry is due to the LP pumps ; it may also be due, in some cases, to malfunction of the transfer sequence slide-valve selector valve).
  When flying with wing pylon tanks, if end of transfer of one of these tanks occurs too soon (as indicated by fuel remaining indicator and fuel transfer indicator), open the crossfeed valve until end of transfer of the other tank, then close the crossfeed valve. In this case, asymmetrical transfer of the fuselage tanks will also probably occur. Depending on the extent of this transfer asymmetry, use the crossfeed valve in the same manner.
- In normal use, the «CROSSFEED» switch in the «ON» position will only create an asymmetry by increasing transfer on the side where a float valve is higher than that on the other side.
- In case of abnormality in the transfer sequence on one side, use of the «CROSSFEED» switch, if justified, should be resorted to only after the failure has been perfectly analyzed. Improper use of the «CROSSFEED» switch may aggravate the trouble.

3 - TRANSFER SEQUENCE

A - Selector switch on "CLEAN"

Tanks on transfer	Feeder tanks	Feeder tank gauges steady	Lights on
	Upon starting The feeder tanks are full ..... The crossfeed cock is closed.	2 x 532.5 litres (2 x 117 Imp. gals) (2 x 141 U.S. gals)	
	Immediately after starting The level drops in the feeder tanks ; the upper float valves are uncovered and permit transfer of	2 x 520 litres	
Pylon ..... then wing	the pylon tanks and ..... the wing tanks	(2 x 114 Imp. gals) (2 x 137 U.S. gals)	ooo then 1
	When these tanks are empty ..... Their self-sealing air valves close. The fuel in the feeder tanks is again consumed ; the next float valves are uncovered, permitting	..... 2 x 490 litres (2 x 108 Imp. gals)	
Forward central ..	transfer of fuel from the forward central tank	(2 x 129 U.S. gals)	
	When the forward central tank is empty ..... Its self-sealing air valve closes. The fuel in the feeder tanks is again consumed ; the next float valves are uncovered, permitting transfer	..... 2 x 390 litres (2 x 86 Imp. gals)	2
Aft lateral	of part of the fuel from the aft lateral tanks	(2 x 103 U.S. gals)	
	When these tanks are empty (by 2/3) ..... A float switch stops the transfer of these tanks. The fuel in the feeder tanks is again consumed ; the next float valves are uncovered, permitting transfer	..... 2 x 340 litres (2 x 75 Imp. gals)	3
Forward lateral...	of fuel from the forward lateral tanks	(2 x 90 U.S. gals)	
	When these tanks are empty ..... Their self-sealing air valves close. The fuel in the feeder tanks is again consumed ; the lower float valves are uncovered, permitting transfer	..... 2 x 290 litres (2 x 64 Imp. gals)	4
Aft lateral	of the fuel remaining in the aft lateral tanks	(2 x 77 U.S. gals)	
	When these tanks are empty ..... Their self-sealing air valves close. The fuel in the feeder tanks is again consumed ; As soon as a gauge reaches	.....	5
	250 litres (55 Imp. gals - 66 U.S. gals) or ..... the aircraft is one minute from the landing pattern, the pilot opens the crossfeed cock.	.....	500 L.
	If the flight continues, the level in the feeder tanks drops to zero	2 x 0	L/H LP R/H LP
Negative-g flight accumulator	It remains the 60 litres (13 Imp. gals - 16 U.S. gals) of the negative-g flight accumulator which can be used.		

B - Selector switch on "WG. PYL. TK"

The transfer principle is identical ; only the transfer sequence of the internal tanks changes and becomes : 1 - 3 - 2 - 5 - 4. The transfer levels in the feeder tanks remain the same.

4 - RELATIONSHIP BETWEEN FUEL GAUGES AND FUEL REMAINING INDICATOR

The figures below allow for the fuel tank top-up buttons whether they are used or not.

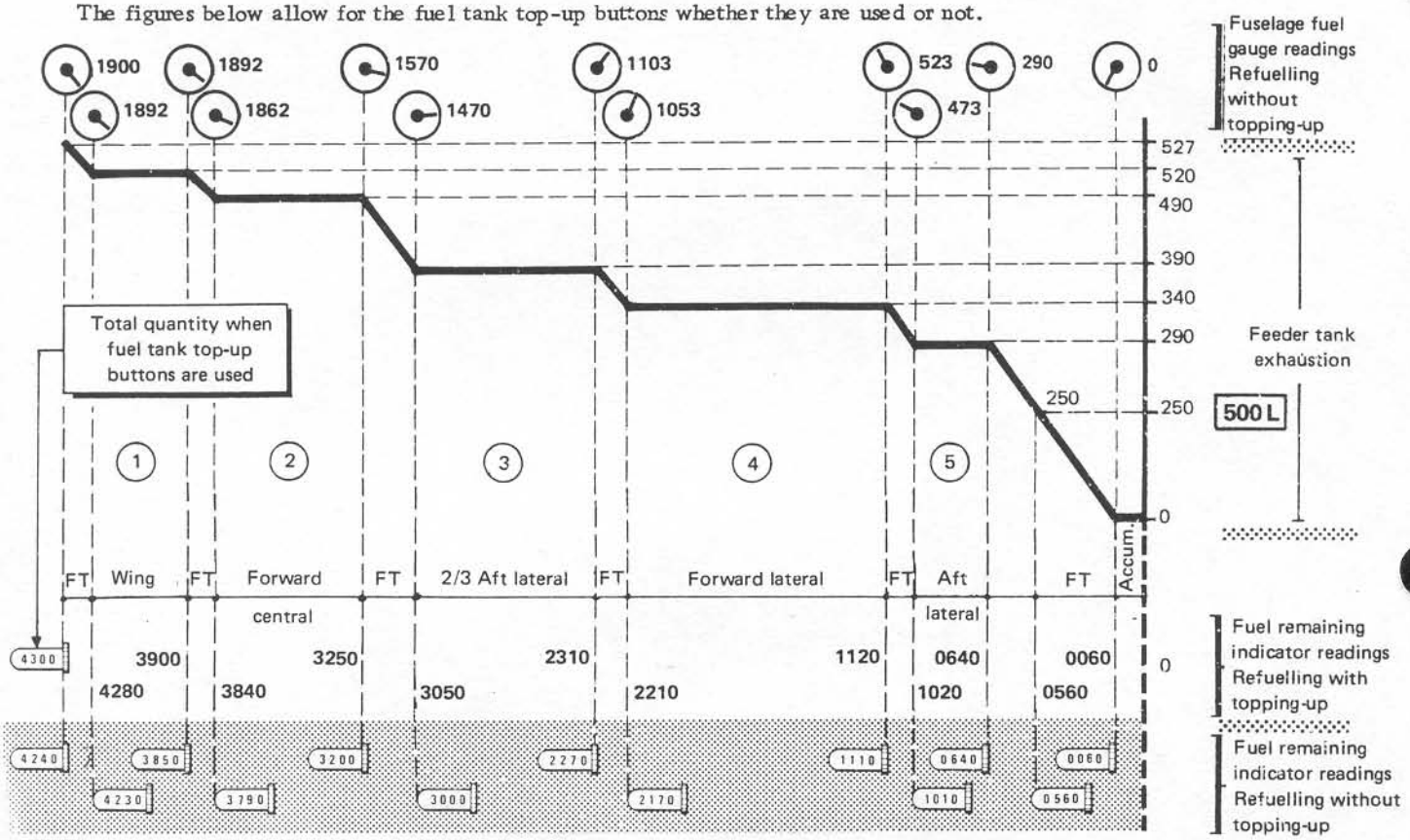


FIGURE 1 – FUEL TRANSFER WITH SELECTOR SWITH ON "CLEAN

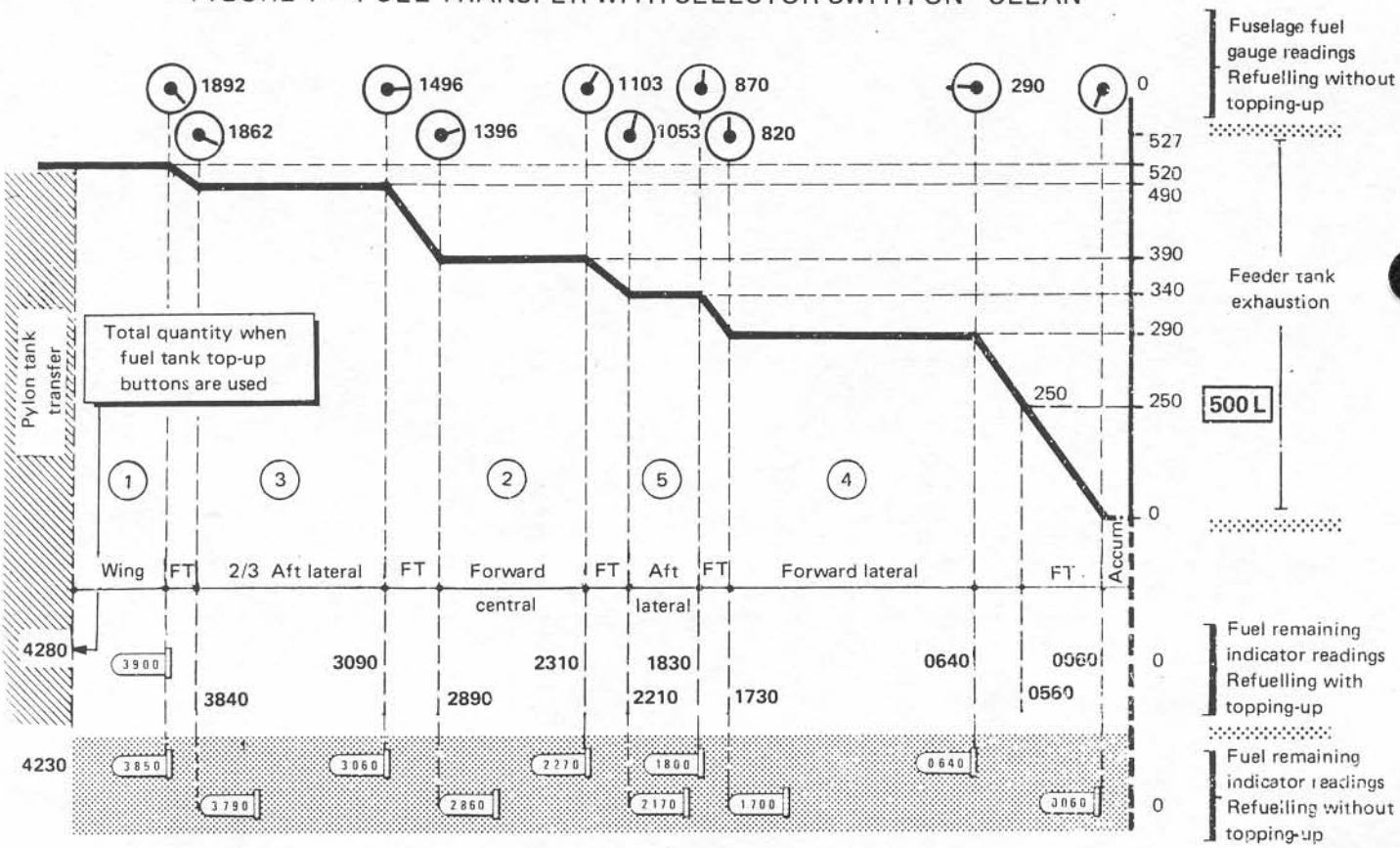


FIGURE 2 – FUEL TRANSFER WITH SELECTOR SWITH ON "WG. PYL. TK"

1,20-4 - FAILURES

LP. light on + warning horn

The engine fuel supply pressure is < 700 mb (10.15 psi).

L/H LP light on

The L/H pump discharge pressure is < 500 mb (7.25 psi).

R/H LP light on

The R/H pump discharge pressure is < 500 mb (7.25 psi).
The starting pump cuts in when the pilot cuts out the R/H pump.

L/H LP + R/H LP lights on

The discharge pressure of each pump is < 500 mb (7.25 psi).
In negative-g flight, the illumination of these two lights is normal.

500 L. light on

The level in one of the two feeder tanks is < 250 litres (55 Imp. gals - 66 U.S. gals).

500 L. light on and 5 out

If the gauge reading confirms the illumination of 500 L. :
part of the fuel in the aft lateral tanks has not been transferred.

1 , 2 , 3 , 4 , 5 lights on can indicate :

- normal end of transfer if the lights come on in the correct sequence
- transfer failure of one tank due to premature closing of its self-sealing air valve.

The non-illumination of these lights can indicate :

- normal transfer is taking place
- transfer failure due to a float valve being jammed closed :
  If it applies to one of tanks 1, 2 or 4, the fuel remaining in these tanks is lost.
  If it applies to one of tanks 3, it may be transferred normally with 5.
  If it applies to one of tanks 3 or 5, it may be transferred by using the emergency transfer system.
- indicating system failure.

TRANSFER FAILURE

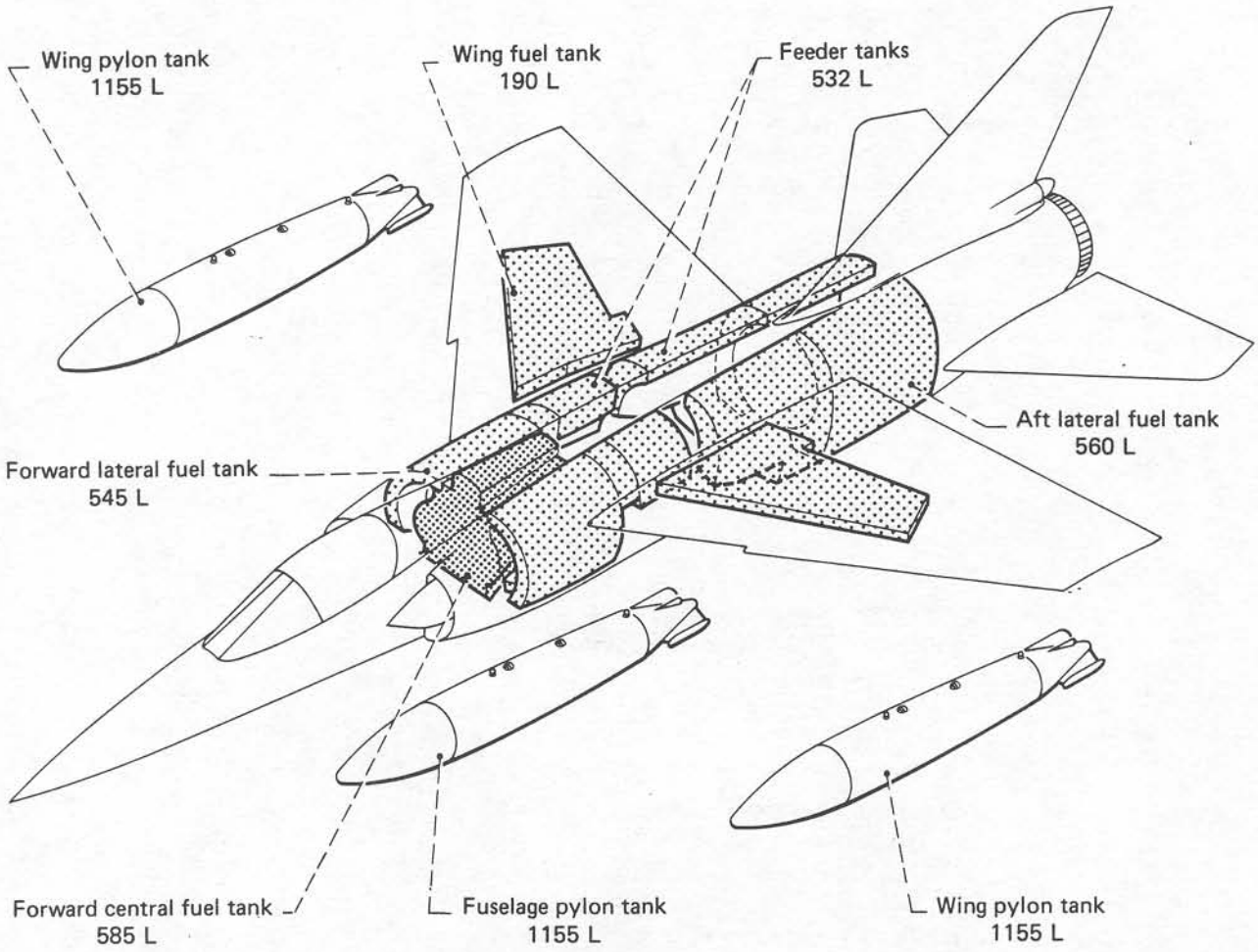
1 , 2 , 4 , 5 come on abnormally

- transfer failure due to lack of pressure

This failure necessitates the use of the emergency transfer system.

ASYMMETRY OF FEEDER TANK GAUGES with illumination of fuel transfer indicator lights in normal sequence

One pump is discharging more than the other.
When a feeder tank gauge stays at its maximum level, the float valve of the tank on transfer is jammed open.
Any asymmetry > 250 litres (55 Imp. gals - 66 U.S. gals) at end of transfer must be reported.



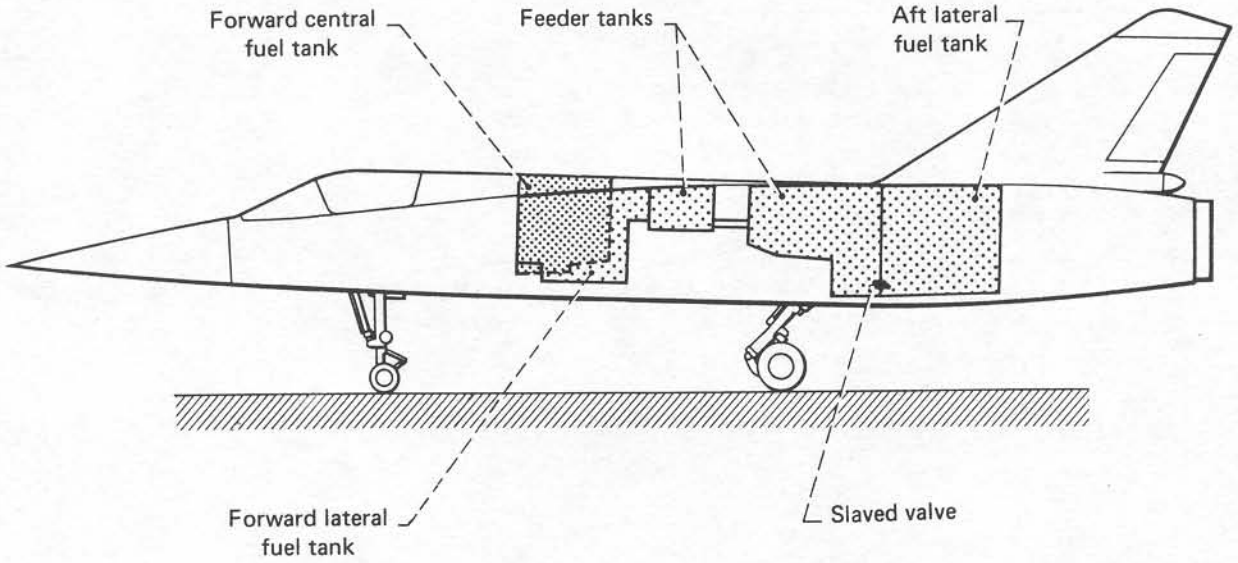


FIGURE 2M – FUEL TANK ARRANGEMENT

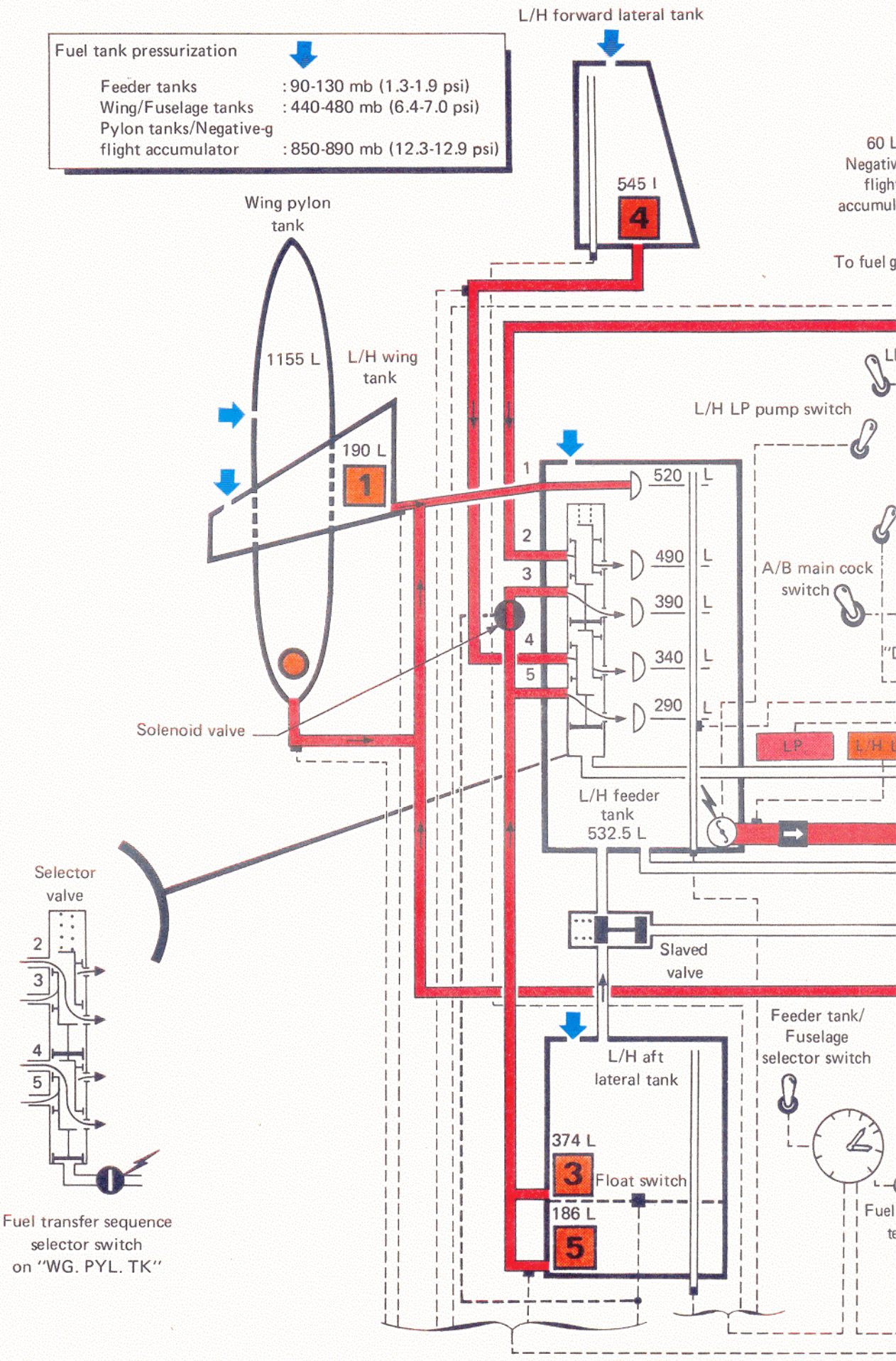
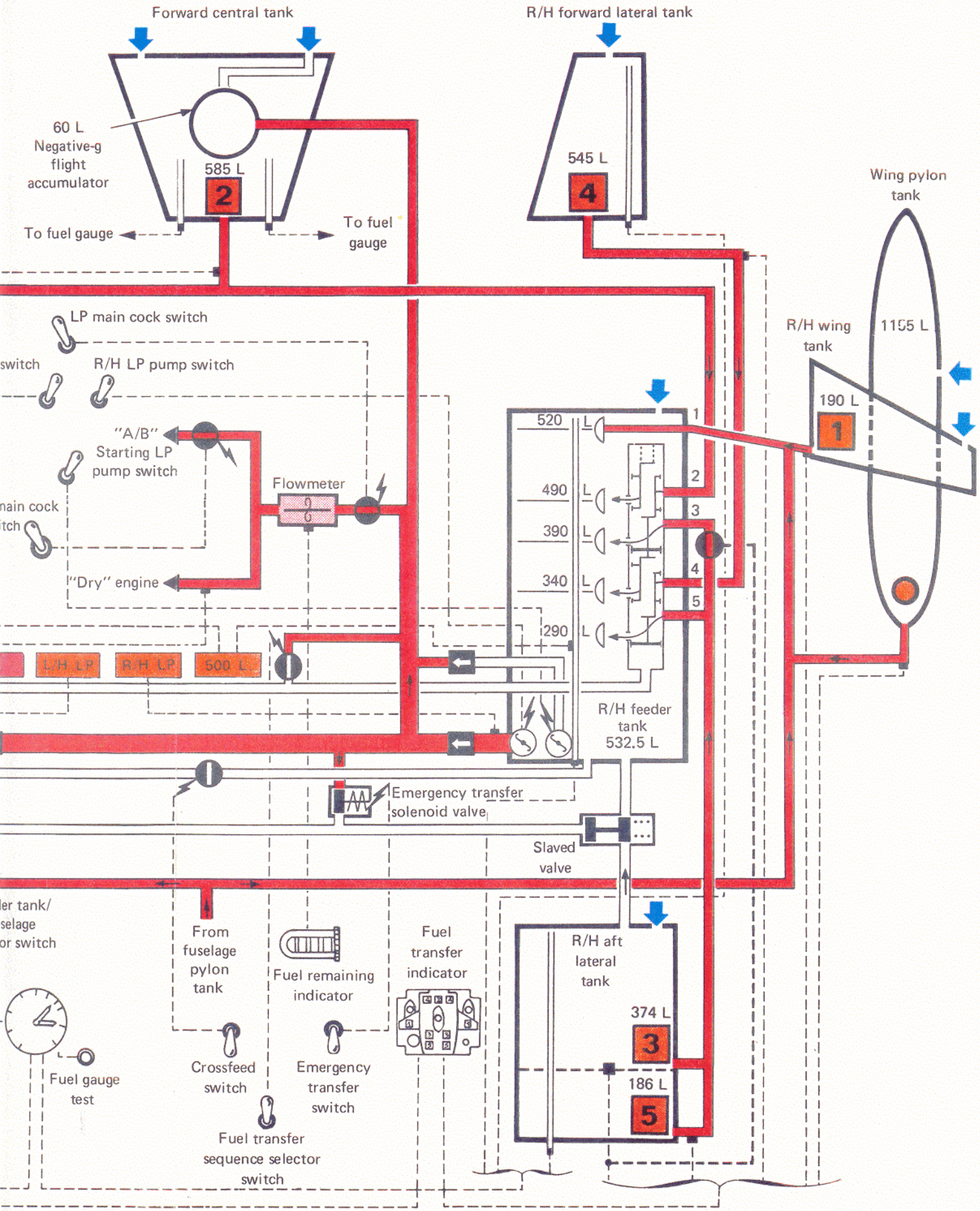


FIGURE 3 - FUEL SUPPLY AND TRANSFER SYSTEM


Forward central tank
R/H forward lateral tank
60 L
Negative-g
flight
accumulator
585 L
2
545 L
4
Wing pylon
tank
To fuel gauge
To fuel
gauge
LP main cock switch
switch
R/H LP pump switch
R/H wing
tank
1105 L
190 L
1
"A/B"
Starting LP
pump switch
Flowmeter
520 L
490 L
390 L
340 L
290 L
1
2
3
4
5
main cock
itch
"Dry" engine
L/H LP
R/H LP
500 L
R/H feeder
tank
532.5 L
Emergency transfer
solenoid valve
Slaved
valve
From
fuselage
pylon
tank
Fuel remaining
indicator
Fuel
transfer
indicator
R/H aft
lateral
tank
374 L
3
186 L
5
Fuel gauge
test
Crossfeed
switch
Emergency
transfer
switch
Fuel transfer
sequence selector
switch

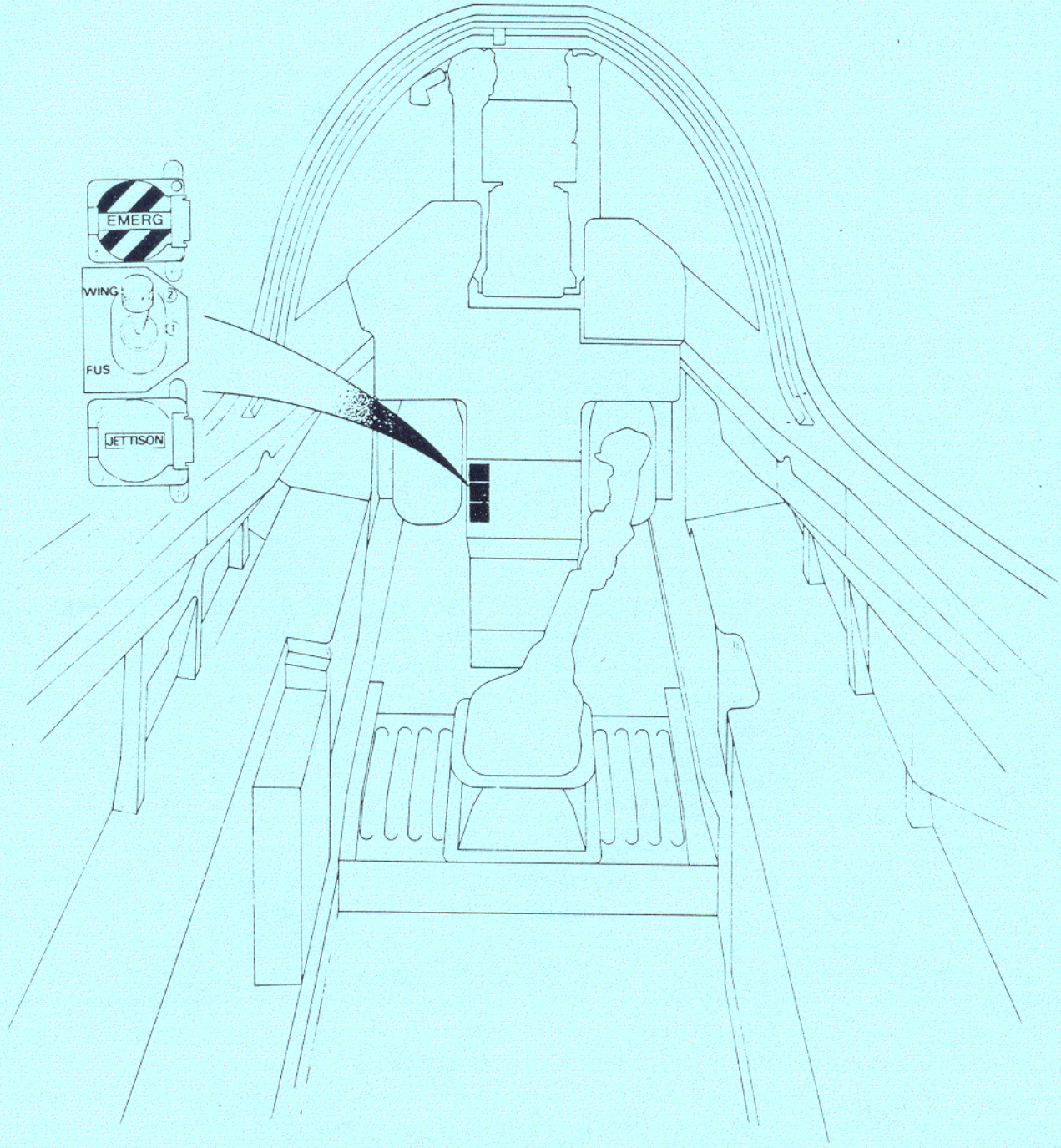


FIG. 4A - FUEL SYSTEM CONTROLS AND INDICATORS

TP 0582

FIGURE 4 – FUEL SYSTEM CONTROLS AND INDICATORS

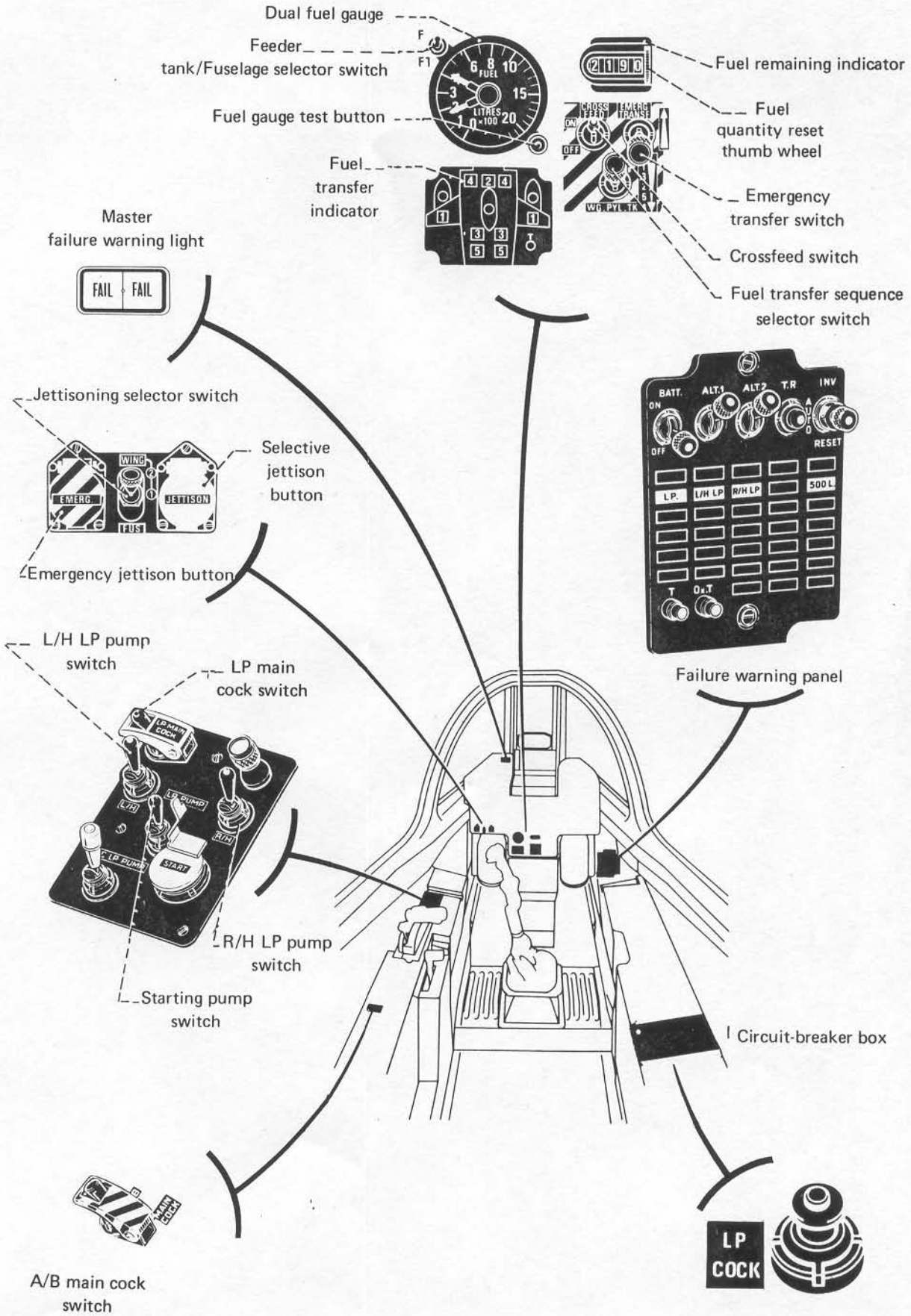


FIGURE 4 - FUEL SYSTEM CONTROLS AND INDICATORS

1,25 – JET ENGINE

1,25 - JET ENGINE

1,25.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
LP SUPPLY	See fuel system		
STARTING	Ignition/Ventilation selector switch	3 positions R/H plug L/H plug Ventilation	Fitted with a stop which can be overridden by lifting switch to select ventilation position
	Start button	Guarded	
	Starting circuit-breaker	"START"	
REGULATION	Throttle lever	2 ranges of travel	The dry sector comprises an idle stop
			The A/B sector is reached by tilting the lever
	RPM indicator	2 pointers graduated in rpm	
	JPT indicator	Graduated in °C	
	JPT emergency regulation switch	2 positions	
	A/B injection light	"INJ", red	Testable
	A/B-on light	"ON", green	Testable
	Failure warning light	"SRL", amber	Testable
	Fire warning light	Red dual { A/B Engine	Testable Pressing this light (to test it) causes the warning horn to operate and checks the detection circuit for continuity
	OIL failure warning light	Red	
	B.O.V light	Red	
FUEL DIPPER	Fuel dipper switch	2 positions	
EMERGENCY REGULATION	Emergency regulation switch	2 positions Guarded	
	Emergency regulation control lever	Spring-loaded neutral position	
	Emergency regulation light	Red	
	Limit warning light	"LIM", red	On when RPM $\geqslant$ 9200 or 109.5 %
	Emergency regulation power supply circuit-breaker	"EMG REG"	
IN-FLIGHT RELIGHT	In-flight relight control	2 positions	Magnetically held for 30 seconds
AIR SUPPLY (SHOCK-CONES)	Shock-cone pushbutton	2 positions depressed : self-held	
	Shock-cone manual control switch	3 positions spring-loaded in neutral position	
	Shock-cone position indicator	Graduated in Mach numbers	

1, 25. 2 - DESCRIPTION

The aircraft is powered by a SNECMA ATAR 9K 50 single-spool turbojet engine. The engine test bed thrust is 6830 daN (15, 355 lbs).

1 - THE ENGINE comprises :

- A Microturbo "NOEL 015" turbo-starter powered by the aircraft battery.
- Three accessory drives driven by the reduction gearbox :
  . accessory angle drive
  . A/B pump drive
  . A/C accessory drive.
- A 9-stage axial flow compressor incorporating two automatically-controlled bleed-off valves.
- An annular combustion chamber fitted with :
  . 2 enrichment nozzles (starting)
  . 2 high-tension igniter plugs (starting and in-flight relight)
  . 20 fuel nozzles (normal operation)
  . 1 A/B ignition fuel nozzle
  . 20 burners.
- A 2-stage turbine.
- The exhaust duct including :
  . a junction section with two upstream manifolds, three A/B burner rings and the JPT measurement system (8 thermocouples)
  . an afterburner chamber and a ionization probe
  . a variable-area multi-flap nozzle actuated by high pressure oil actuators.
- Thrust is controlled through a single throttle lever which acts on :
  . the main FCU
  . the A/B FCU

  and automatically maintains a constant rotational speed and turbine inlet temperature.

The engine also comprises :

- A main regulation system, including :
  . the fuel regulation system
  . the RPM regulation system
  . the stop regulation system
  . the temperature regulation system
  . the overspeed system
  . a bleed-off valve system.
- An emergency regulation system
- An A/B system, including :
  . the A/B regulation system
  . the SRL (slam relight lighting) system
  . an A/B overboost system.
- A fuel dipper.

2 - FUEL SYSTEM

- Dry engine

The LP fuel flows through the engine-driven HP pump and reaches the main FCU where it is metered through the throttle lever or the emergency regulation control lever. Then, through the main pressurizing and dump valve, this fuel is directed to the dual-orifice fuel nozzles which spray it into the combustion chamber.

- Afterburner

The LP fuel flows through the centrifugal pump, which is itself driven by the engine, then it reaches the A/B FCU where it is metered in relation to the A/B power. The A/B pressurizing and dump valve then directs the fuel to the burner rings and the upstream manifolds.

3 - OIL SYSTEM

It consists of two systems and a single oil tank.

- Lubrication oil

- A main system, supplied by the oil tank, lubricates the turbo-jet engine assembly.
  The lubrication oil of bearings 2 and 3 is lost, which gives an oil consumption of 0,8 to 1,5 liter per hour.
  The main oil system has an endurance of approx. 6 hours (see VOLUME 3).

- An emergency system, supplied by the emergency reserve in the oil tank, lubricates bearing 1 only for 20 minutes, irrespective of the power setting.

- Regulation oil

The LP oil pump supplies the main FCU.
The HP oil pump supplies :
- the exhaust nozzle actuators, which progressively close the exhaust nozzle from 6900 rpm,
- the overspeed system hydraulic control.

4 - AIR SYSTEM

Several systems supplied with P2 air tapped at the engine center casing, ensure :
- regulation system operation,
- flexible deflector anti-icing and cooling of certain engine components,
- cockpit and equipment bay air conditioning,
- fuel tank pressurization.

5 - AIR SUPPLY - PURPOSE OF SHOCK-CONES

Air supply is provided by two semi-circular lateral air intakes, in which automatically or manually adjustable shock-cones (mice) move longitudinally.
During engine run-up, during take-off and under certain flight conditions, additional air intake doors open under the effect of negative pressure in the inlet duct, thus improving the engine air supply.
In supersonic, the shock-cones are progressively moved forward so as to reduce the intake throat area and prevent the absorption of shock waves ; the shock-cone movement schedule is determined by the Mach number supplied by the air data computer.
The shock-cones are actuated by a hydraulic motor (system 1) controlled by a servo-valve supplied with DC current.

6 - ELECTRICAL SYSTEM

- Engine power supply
- 28 V DC : fed from battery or ground power unit.

The use of the ground power unit, during the turbo-starter operation, necessitates the protection of the electrical starting motor of the latter. This protection is obtained, in aircraft, by the automatic cutout of the ground power unit during the starting sequence.

- 400 Hz AC - 208 V (three-phase) and 115 V (single-phase)

This power supply (which is used only on the electronic regulation unit TV 815) is ensured in aircraft
. by the two 208 and 115 V alternators (normal operation),
. by a 115 V inverter (emergency operation, partial supply of the unit).

7- FIRE DETECTION

Overheat and fire detectors are placed in the engine area, close to «hot» points, and also in the AB area ; they control the illumination of the corresponding section of the dual fire warning light.
The system comprises a safety device which prevents untimely illumination of the fire warning light (open-circuit or grounding).
During fire detection system testing, pressing the «ENG-A.B» light tests not only the lamp but also the circuit.

8- CHARACTERISTICS

A - Normal Regulation

	Cockpit Instrument Readings		
Power Setting	Rotational Speed in rpm	JPT in °C on the Ground	in Flight
Idle*	2900 ± 100		
Military thrust	8400 ± 60	740 < JPT < 755	JPT < 760
Min. AB	8400 ± 60	740 < JPT < 755	JPT < 760
Max. AB	8400 ± 60	740 < JPT < 755	JPT < 760
with overspeed	8900 ± 60		JPT < 735

NOTE : In certain cases, for example with a cold engine, although the throttle is set to IDLE, the rotational speed of the engine may be below normal or vary between 2600 and 3200 rpm with small JPT variations. This phenomenon should disappear as soon as the engine is warmed up.
In flight, at idle, the JPT is below 200° C and cannot be read by the pilot.

B - Emergency Regulation

See SECTION 3, para. 3,25.8.

1,25.3 - OPERATION

1 - STARTING

An external power source is not necessary to start the engine.
However, an auxiliary power unit can be used to supply the utility systems ; the aircraft battery continuing to supply the starter.
The starter is a gas generator driven by a low-power electric motor. It includes an electric fuel pump, a regulation system and a number of interlocks.
The exhaust gases drive a free turbine which is made integral with the rotor of the engine through a releasable reduction gear (free wheel type drive).

Starting sequence

Starting takes place in four phases :

A - With the throttle set to STOP, the LP main cock open, the LP pumps on and the ignition/ventilation selector set to "IGN" "P" or "S", the pilot :
- lifts the starter button guard, which has the effect of starting the starting pump (extinction of the L P light on the failure warning panel)
- then depresses the starter button, which has the effect of :
  . supplying the starter electric fuel pump
  . supplying the electric motor and igniting the gas generator
  . triggering the crash recorder.

B - When the gas generator has reached a certain speed :
- the electric motor and starter ignition are cut off
- the starting solenoid valve of the engine opens and the starting fuel nozzles start to inject fuel
- the engine igniter plug is supplied
- the starting by-pass opens.

During this time, the free turbine gradually starts to drive the engine.

C - Between 300 and 600 rpm, the pilot moves the throttle to IDLE ; fuel reaches the main fuel nozzles under low pressure (because of the bypass which is open) : the engine accelerates and lights up a about 1200 rpm.

D - When the engine reaches 2150 rpm, a starting relay controlled by a pickoff (phonic wheel) stops all the operations described in A and B above and, in particular, closes the bypass.

Fuel flow increases and the engine accelerates under its own power until it reaches idling speed.

NOTE 1 : The best way to monitor the engine for proper starting is to listen to the various sequences which each produce a peculiar noise. This is very easy with some experience and facilitates interpretation of the indications provided by the RPM and JPT indicators.

NOTE 2 : Cold engine starting :
- Between 300 and 600 rpm, move the throttle slightly beyond the idle position. The metering valve opening command is then larger and valve operation faster.

- As soon as the engine starts accelerating (at 2500 rpm), imperatively move the throttle back to idle so as to prevent starter turbine disintegration in case of cutout circuit failure.

Special case : MOTORING

After a false start, it may be necessary to perform a DRY MOTORING. This is performed as for normal starting, but :
- the ignition/ventilation selector is set to "VENT", which has the effect of cutting off the fuel supply to the starting fuel nozzles and the electrical supply to the plug
- the throttle is left at STOP

(The procedure is described in SECTION 4 - para. 4,25.1.3)

STARTING SAFETY SYSTEMS

Safety systems are provided in case the automatic starting sequence does not proceed normally :

A - If the starter fuel pressure does not reach a given value, a timer stops the starting sequence at the end of 12 seconds.

B - If starting and acceleration of the starter do not proceed normally, a timer stops the starting sequence 7 seconds after energization of the starter.

C - If the engine does not start normally, i.e. the engine does not reach 2150 rpm, the timer also stops the starting sequence 12 seconds after the start of the 2nd phase.
It is this 12-second safety system which normally stops the starting sequence when a ventilation is performed.

REMARK : The pilot cannot directly control stopping of the starting sequence (except by pulling out the "START" circuit-breaker).

2 - IN-FLIGHT RELIGHT

The in-flight relight control is normally off. When it is switched on, it is self-held in this position for 30 seconds. This has the effect of :
- opening the starting solenoid valve
- igniting the R/H and L/H plugs (provided the ignition/ventilation selector switch is on "IGN" "P" or "S").
In-flight relight procedures are dealt with in Section 4.

3 - MAIN REGULATION

The main function of the main regulation system is to provide for fuel supply to the combustion chamber.
The main FCU is mechanically controlled by the speed selector which receives pilot's commands through the throttle lever and acts on the RPM regulation system.
The main regulation system is composed of six components each having a special function but all being interdependent.

A - Fuel regulation system

The fuel regulation system essentially consists of the metering valve which meters the fuel flow.
The stop valve, controlled according to the throttle lever movement through the speed selector, allows the metered fuel to flow through the pressurizing and dump valve or to be by-passed to the return circuit.
The metering valve moment is controlled by the RPM regulation system within the limits determined by the stop regulation system.

B - RPM regulation system

The RPM regulation system controls the metering valve according to the engine rotational speed in order to ensure a fuel flow suited to the selected rotational speed.
In addition, it determines the following characteristic power settings :
- idle (RPM = 2900 or 34.5 %)
- full power dry or A/B (RPM = 8400 or 100 %)
- overspeed (RPM = 8900 or 106 %), controlled by a Mach number signal.

C - Stop regulation system

Two stops acting on the metering valve limit the fuel flow in order to increase the margin of surge due to throttle lever movements or certain flight conditions.
The control of this dual stop is slaved to :
- an RPM/P2 stop corrector
- a P2/P1 stop corrector

} to regulate throttle lever movements

- a stop limiter solenoid valve which operates according to H, IAS, i and engine rpm under the following conditions :

INCIDENCE	ALTITUDE	DRY	A/B
i > 14° whatever IAS	H > 27,500 ± 1500 ft	whatever RPM	RPM > 8100 or 96 %
	H < 27,500 ± 1500 ft	RPM < 8100 or 96 %	without
whatever i IAS ⩽ 255 kt	H > 27,500 ± 1500 ft	whatever RPM	RPM > 8100 or 96 %

REMARKS: Effect of this regulation for the pilot :

A) The first two correctors have no direct effect for the pilot, except for the engine which does not react rapidly.
B) On the other hand, the stop limiter, when energized, acts on the operation of the exhaust nozzle flaps through the temperature regulation system.
1. The RPM governing system maintains the engine rpm with a ± 80 (1 %) rpm hunting (2- to 4-second period).
2. The temperature regulation system opens the exhaust nozzle flaps, which may cause the JPT to drop down to 550°C under extreme conditions.

D - Temperature Regulation

The purpose of this regulation is to associate to each rotational speed an operating JPT which tends to optimize the engine consumption.
Schematically, the temperature regulator, subjected to the action of a ΔP, supplies the exhaust nozzle actuators with high pressure oil, thus controlling the exhaust nozzle area variation.
From full power, an electronic JPT regulation system, associated with a JPT conformation box, maintains the temperature constant irrespective of the flight conditions.
The JPT conformation box specially provides, for certain characteristic operating points, the same JPT reading in all aircraft though there are noticeable variations from an engine to another.

REMARKS:

1. In certain cases of failure, the pilot can cut out the electronic JPT regulator. In this case, for a same engine rpm, the JPT will be lower.
2. The exhaust nozzle flap hydraulic system has a solenoid valve actuated by :
   - the «emergency regulation» control
   - the «firing fuel dipper» control (missile firing)

   Energizing this solenoid valve controls immediate opening of the exhaust nozzle flaps.
3. To the pressure regulator itself is associated a mechanical valve the bleed flow of which is also controlled by the throttle. This valve is adjusted so as to vent the β P2 pressure at low engine rpm, thus causing the exhaust nozzle to immediately open in case of reduction (RPM < 6800 or 81 %).

E - Overspeed System

The overspeed system, controlled by a signal from the air data computer (Mach 1.4), acts on the RPM governing system through the speed selector (supplied with high pressure oil).
The engine rpm increases to 8900 (106 %), which improves the performance by increasing the air flow.
Simultaneously, the JPT regulation system causes a JPT drop so as to maintain a turbine inlet temperature identical to that existing during normal full power operation.

F - Bleed Valves

These valves divert part of the air compressed by the first four stages of the compressor. This air bleed prevents partial stalls or even flameouts and also reduces the stresses affecting the vanes of rotating wheel 1 (RW1) to acceptable values.
The valves are controlled by springs which hold them open up to about 4000 (47.5 %) rpm, and by an electronics box which opens or closes them according to the following logic :

- RPM < 6700 (80 %) : valves open
- RPM > 7000 (83.5 %) : valves closed
- stresses on RW1 : opening signal if RPM < 8100 (96 %)

To avoid directing very hot air into the engine compartment, the electronics box prevents opening of the bleed valves at engine speeds higher than 8100 (96 %) rpm.

The B.O.V. light comes on :

- in case of disagreement between the given signal and the position of the valve
- if the given signal does not correspond to the control logic
- when RW1 stresses are detected regardless of the engine rpm
- if the 15/28 V power supply of the TV 815 has failed

NOTE : Momentary illumination of the B.O.V. light may occur due to interferences in the detection circuit. This untimely operation should occur only when the JPT emergency regulation switch is actuated or the inflight relight switch is on, and at 6500 < RPM < 7000 (77.5 % < RPM < 83.5 %).

REMARKS: Effect of this regulation for the pilot :

A) The first two correctors have no direct effect for the pilot, except for the engine which does not react rapidly.
B) On the other hand, the stop limiter, when energized, acts on the operation of the exhaust nozzle flaps through the temperature regulation system.
   1. The RPM governing system maintains the engine rpm with a ± 80 (1 %) rpm hunting (2- to 4-second period).
   2. The temperature regulation system opens the exhaust nozzle flaps, which may cause the JPT to drop down to 550°C under extreme conditions.

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2. The exhaust nozzle flap hydraulic system has a solenoid valve actuated by :
   - the «emergency regulation» control
   - the «firing fuel dipper» control (missile firing)

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- RPM > 7000 (83.5 %) : valves closed
- stresses on RW1 : opening signal if RPM < 8100 (96 %)

To avoid directing very hot air into the engine compartment, the electronics box prevents opening of the bleed valves at engine speeds higher than 8100 (96 %) rpm.
In case of disagreement between the signal from the electronics box and the position of the valves, the red B.O.V light comes on.
It may be the case, for example, when RW1 stresses are detected above 8100 (96 %) rpm.

4 - EMERGENCY REGULATION SYSTEM

The emergency regulation system compensates for :

- most of the oil failures
- most of the rpm freezing cases.

It enables the engine rpm to be adjusted through direct action on the main FCU metering unit within a reduced envelope.

There is no more automatic regulation of the engine speed.

The emergency regulation switch, when turned on :

- energizes the control lever (illumination of the emergency regulation light)
- controls opening of the exhaust nozzle (solenoid valve)
- energizes the bearing 1 lubricating oil micropump.

NOTE : Opening of the exhaust nozzle, by means of the emergency regulation switch, causes an important thrust drop. For information, the maximum engine thrust, in the emergency regulation mode, is approximately equal to that obtained in the normal regulation mode around 7300 rpm at 1500 ft - 200 kt - ISA, i.e., about 43 % of the maximum thrust.

The control lever controls an electric actuator which directly acts on the fuel metering unit (in the fuel flow increasing direction), thus allowing the necessary engine rpm to be set. The fuel flow is reduced through an anti-overspeed spring as the actuator retracts.

REMARKS :

1. The pilot must act on the control lever in small steps (no rpm regulation ; the response is long).
2. The AB cannot be ignited in the emergency regulation mode.
3. A relay prohibits any energization of the starter during emergency regulation.
4. Turning the emergency regulation switch off automatically places the electric actuator in the full reduced position and extinguishes the emergency regulation light.
5. The emergency regulation system must not be switched on during overspeed system operation.

5 - AFTERBURNER

Injection of fuel into the gases from the turbine increases the temperature, which increases the exhaust jet velocity. This gives an important thrust gain.

- The AB regulation system acts as a function of two parameters :
  - selection of the degree of reheat (throttle)
  - P2 air pressure which represents the quantity of air available for the AB (variable with flight conditions).

- AB ignition and slam relight lighting (SRL) system

  The SRL system permits the throttle to be directly moved from any position of the dry quadrant to any position of the AB quadrant.
  The pilot slams the throttle and when N > 8100 (96 %) rpm for more than 3 seconds (SRL), the AB regulation unit, through the TV 815, authorizes the following :
  - operation of the AB fuel pump
  - energization of the AB ignition fuel nozzle
  - illumination of the "INJ" light
  - arming of the 8-second interlock which will automatically cut off AB injection in case of ignition or detection failure.

  - the ionization probe detects AB ignition and controls the following :
    . cutoff of AB injection
    . extinction of the red "INJ" light
    . illumination of the "ON" light
    . closing of the SRL circuit (which will remain closed as long as the "ON" light is on) after a 1.7-second delay.

REMARKS :

1. The AB is designed to operate only when the engine is at its maximum power setting.
   The JPT does not change.
2. If the «ON» light is already or still on in the dry quadrant, AB ignition may be attempted if JPT $\geqslant 600^{\circ}$ C but must be effected at min. AB (non-indicated SRL system failure).
3. If the «SRL» warning light is on, attempt to ignite the AB in the same conditions as above.
4. The SRL system failure (solenoid valve which remains open during AB operation) is not indicated, whereas the «ON» light is on.
   This failure results in a thrust loss of about 20% of the total thrust, which corresponds to a thrust lower than min. AB thrust.
5. If the «INJ» light remains on for more than 10 seconds, shut off the AB.
6. The AB regulation system normally ensures automatic AB reignition in case of accidental flameout.
   In this case, it is imperative to move the throttle back to mid-travel in the AB quadrant (this flameout usually occurs at envelope limit).

- AB Overboost System
  This system is automatically engaged above 27,500 ft.
  The air data computer feeds the overboost solenoid valve with an opening signal ; this valve enriches the mixture, which results in a 40° C temperature increase not legible on the JPT indicator.

6- FIRING FUEL DIPPER

The gun/missile firing fuel dipper is an engine protection against the risks of compressor stall which may result from the following :

- ingestion of hot exhaust gases during firing (case of missiles), or
- sudden air rarefaction due to the pressure wave

The engine is momentarily leaned during firing, which has the effect of increasing the compressor surge margin.
This leaning is obtained by bypassing a certain quantity of metered fuel.
The firing fuel dipper is energized when :

- the armament control panel «F DIP» switch is on
- the «ARM. M.» armament master switch is on

In addition, operation of the missile firing fuel dipper circuits is dependent on :

- actuation of at least one of the following armament control panel pushbuttons : LH or RH 550 missile or fuselage missile

A - Gun Firing

In short-duration firing, the gun firing solenoid valve is energized during 0.8 second from the «trigger» signal.
In long-duration firing, the solenoid valve remains open throughout the trigger actuation duration.

B - Missile Firing

- Pressing the firing button causes :
  . opening of the exhaust nozzle
  . automatic shutoff of the AB if it is ignited or ignition prohibition if it is not

- Departure of a missile results in the following :
  . simultaneous opening of three solenoid valves
  . a time delay box then controls successive closing (0.8 s, 3 s, 5 s) of the latter valves, thus ensuring progressive reacceleration of the engine
  . at the end of 10 seconds, the exhaust nozzle closes and the AB is automatically reignited if the throttle is still in the AB quadrant

  After application of both modifications Nos. 909 and 910
  The exhaust nozzle opening duration is reduced from 10 seconds to 3 seconds, automatic AB reignition occurs 3 seconds after nozzle closing, and successive closing of the solenoid valves is reduced to 0.8, 1.5 and 2.8 seconds after their opening.

- A complementary dual sequence box causes the leaning sequence to restart when a second 550 missile is fired less than 10 seconds after the first one, provided that the armament control panel missile switch is on.

6.1 - FIRING FUEL DIPPER OPERATING CONDITIONS

During gun or missile firing (See instructions in Book 3)
The firing fuel dipper operates only when the initial engine rpm is higher than 7300 (87 %).

6.2 - PRACTICAL REACTION FOR PILOT

At 30, 000 ft, with the throttle in the full power dry position or within the A/B quadrant, the missile firing fuel dipper causes :

- engine rpm drop down to 7200 (85.5 %), then progressive increase up to maximum rpm which is reached at the end of 7 to 8 seconds (rpm variations are all the more sudden as the Mach number is greater)
- JPT drop below 600°C, then start of increase at the end of 13 to 18 seconds.

REMARKS :

1. The missile firing fuel dipper operates only when the concerned missiles are present. On the other hand, the 550 and 530 training missiles allow complete operation of the sequence.
2. The firing fuel dipper does not operate during emergency regulation.
3. The complementary unit prohibits gun firing leaning during a missile firing leaning sequence.

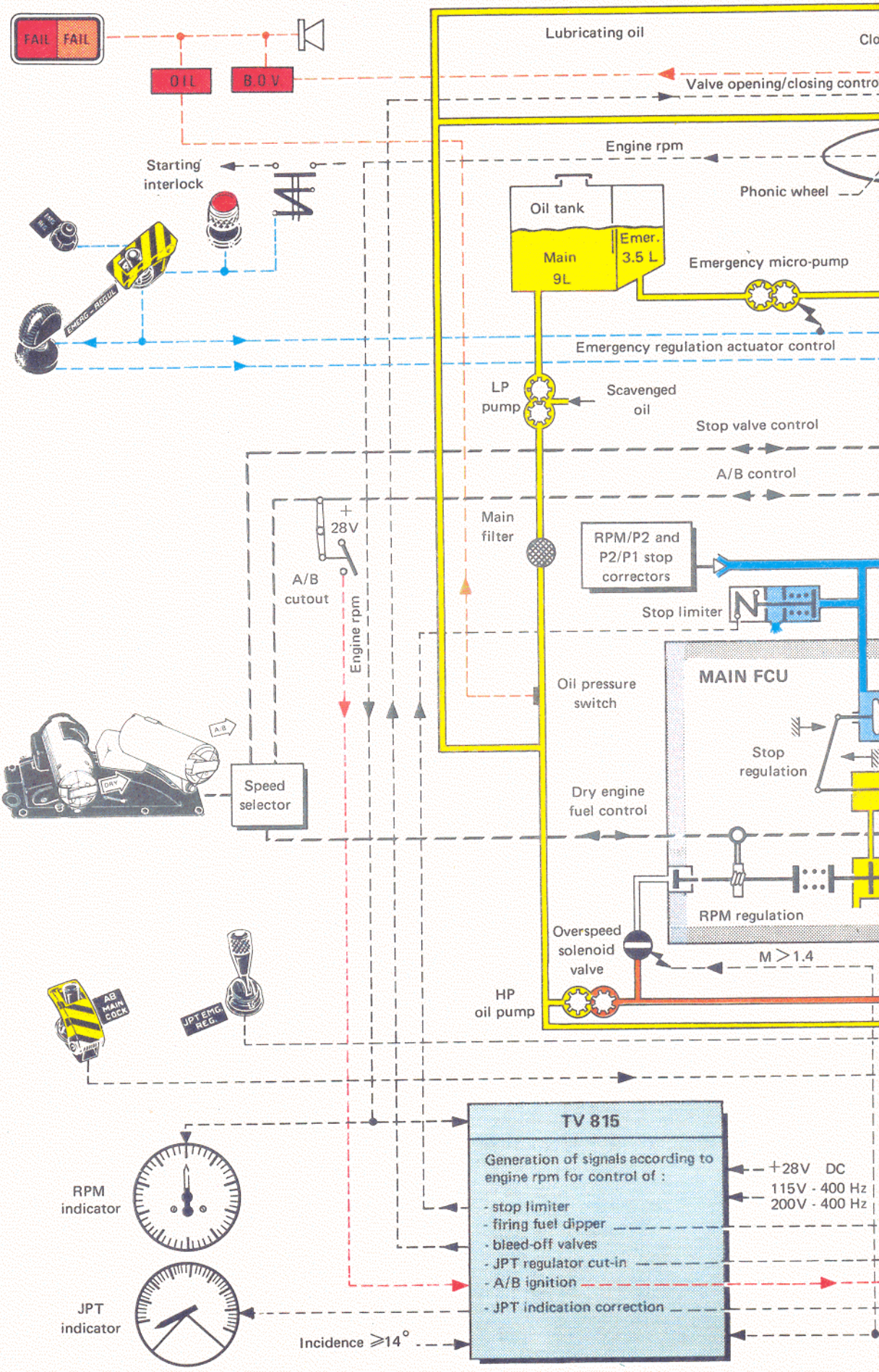
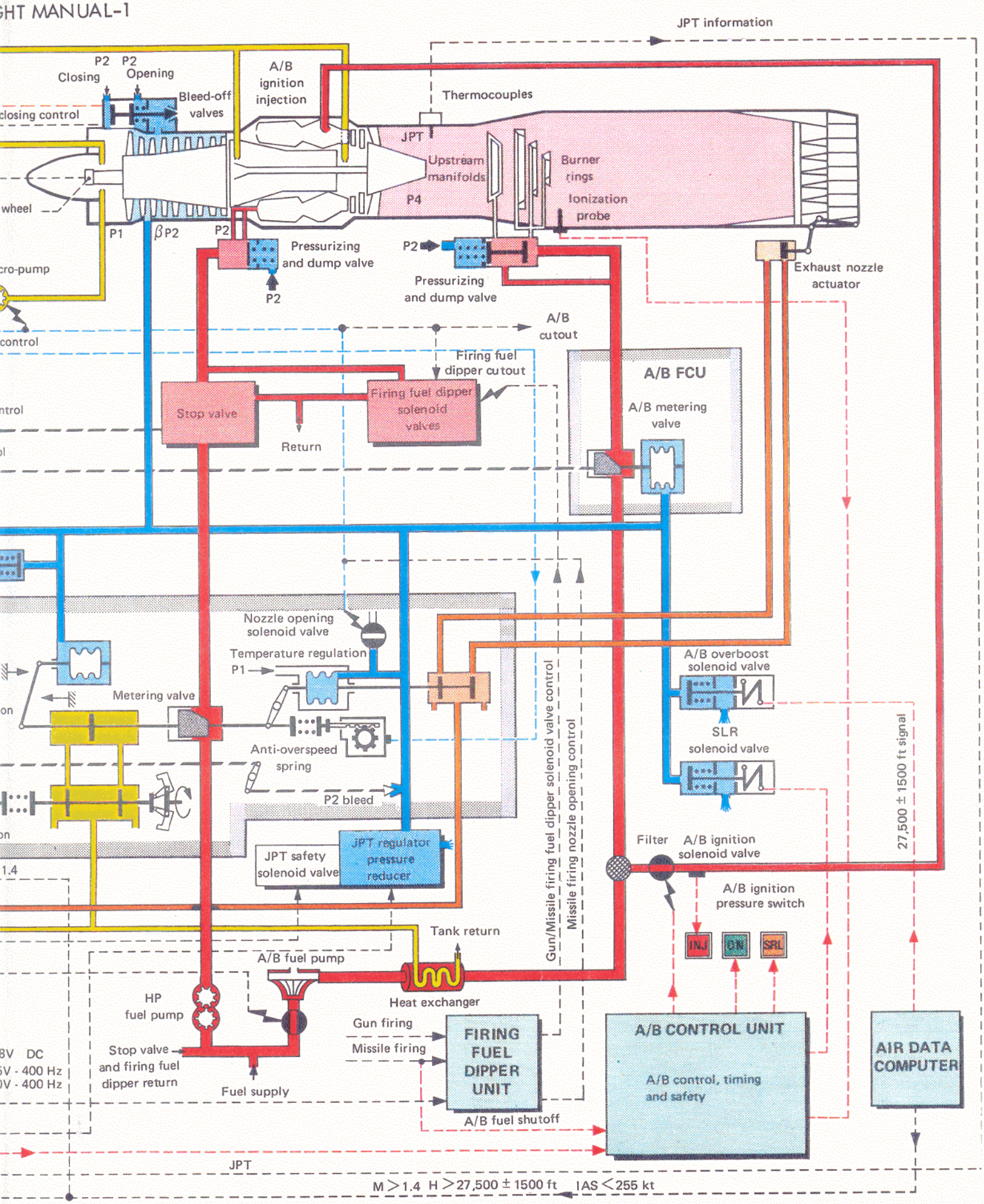


FIGURE 1 – DRY ENGINE AND A/B FUEL REGULATION


JPT information
P2 Closing
P2 Opening
Bleed-off valves
A/B ignition injection
Thermocouples
JPT
Upstream manifolds
Burner rings
P4
Ionization probe
P1
βP2
P2
Pressurizing and dump valve
P2
P2
Pressurizing and dump valve
Exhaust nozzle actuator
A/B cutout
Firing fuel dipper cutout
A/B FCU
A/B metering valve
Stop valve
Return
Firing fuel dipper solenoid valves
Nozzle opening solenoid valve
Temperature regulation
P1
Metering valve
Anti-overspeed spring
P2 bleed
A/B overboost solenoid valve
SLR solenoid valve
27,500 ± 1500 ft signal
Gun/Missile firing fuel dipper solenoid valve control
Missile firing nozzle opening control
JPT safety solenoid valve
JPT regulator pressure reducer
Filter
A/B ignition solenoid valve
A/B ignition pressure switch
INJ
ON
SRL
Tank return
A/B fuel pump
HP fuel pump
Heat exchanger
Gun firing
Missile firing
FIRING FUEL DIPPER UNIT
A/B CONTROL UNIT
A/B control, timing and safety
AIR DATA COMPUTER
Stop valve and firing fuel dipper return
Fuel supply
A/B fuel shutoff
JPT
M > 1.4 H > 27,500 ± 1500 ft IAS < 255 kt
Emergency regulation
A/B control and indicating
Warning

1,25.4 - FAILURES

OIL light on + warning horn

Pressure at the pump outlet is < 0.75 bar (11 psi).
The loss of oil pressure is a serious failure ; it leads to erratic operation of the main FCU (risk of overspeed) and can also cause engine seizure due to lack of bearing 1 lubrication.

OIL light on + warning horn + RPM indicator near 0

This is a failure of the engine accessory support gearing which affects all engine regulation and leads to oil pump drive failure.

OIL light out upon starting, before engine rpm = 2000 (23.8%)

This is a failure due to faulty operation of the oil pressure switch.

FUEL REGULATION FAILURES

In addition to the case of failure of the oil system, operation of the fuel control system may be affected either by an internal failure of the FCU, or by a failure of the throttle control. The pilot notices stabilization of the rpm at any value and the ineffectiveness of the throttle.

OVERSPEED SYSTEM

If the overspeed system cuts in or remains in operation below Mach 1.4, the failure may arise from a defect in the air data computer. There is a risk of compressor stall at low flying speeds.

PERMANENT OPERATION OF FIRING FUEL DIPPER

This may be caused by a relay of the timer box being permanently energized ; in this case, the incident results in :
maximum rpm being less than normal, or
low JPT, or
both of these abnormalities.

THRUST SURGES

This failure is evidenced by rough thrust surges and engine rpm variations.
If the thrust surges are rapid, the JPT does not vary ; the oil warning light remains out.
The failure may lead to jamming of the nozzle flaps in the full open position.
The JPT then decreases and the thrust decreases.

THRUST DROP AT TAKEOFF

If the pilot notices a thrust drop, confirmed by a JPT drop, without a decrease in rpm, this is caused by an accidental opening of the nozzle flaps.

ASYMMETRICAL THRUST

An asymmetry in nozzle flap displacement or position produces a jet deflection resulting in pitch or yaw moments, particularly during AB operation.

ENGINE OR AB FIRE WARNING LIGHT ON

If a «FIRE» warning light comes on and then goes out, this may indicate a violent fire : destruction of the fire warning light power supply circuit.

«SRL» FAILURE WARNING LIGHT

Failure of the slam relight lighting system.

CAUTION

THIS WARNING LIGHT DOES NOT INDICATE ALL FAILURES OF THE SRL SYSTEM.

In case of malfunction of the SRL system, engine protection is no longer assured and there is a risk of compressor stall on AB ignition with a high degree of reheat. Electrical failure of the SRL system is indicated by the illumination, in dry engine operation, of the «SRL» light.

AB «INJ» (INJECTION) LIGHT

When the AB is ignited, engine hunting often occurs.
If this light does not go out, there is a risk of serious damage to the turbine.

AB «ON» (OPERATION) LIGHT

This light often goes out only several seconds after the AB is actually shut off, specially at altitude ; however, if the light does not go out, or goes out only after the throttle is set to idle, there may be abnormalities in the AB detection system or a defect in the AB fuel supply.

B.O.V. light on

Illumination of this light indicates a position in disagreement with the bleed-off valve opening control signals.

SHOCK-CONE FAILURE

The compressor may stall and engine flameout occur.

JPT ABNORMALITIES

These may be due to the JPT regulator, the indicating system, the electronic regulation system or the basic regulation system.

STARTING INCIDENTS - See SECTION 4

«LIM» WARNING LIGHT COMES ON IN EMERGENCY REGULATION

This may be encountered during go-around, with full power during emergency regulation, on high-elevation fields and under hot weather conditions.

FIGURE 1 – ATAR 9K 50 JET ENGINE

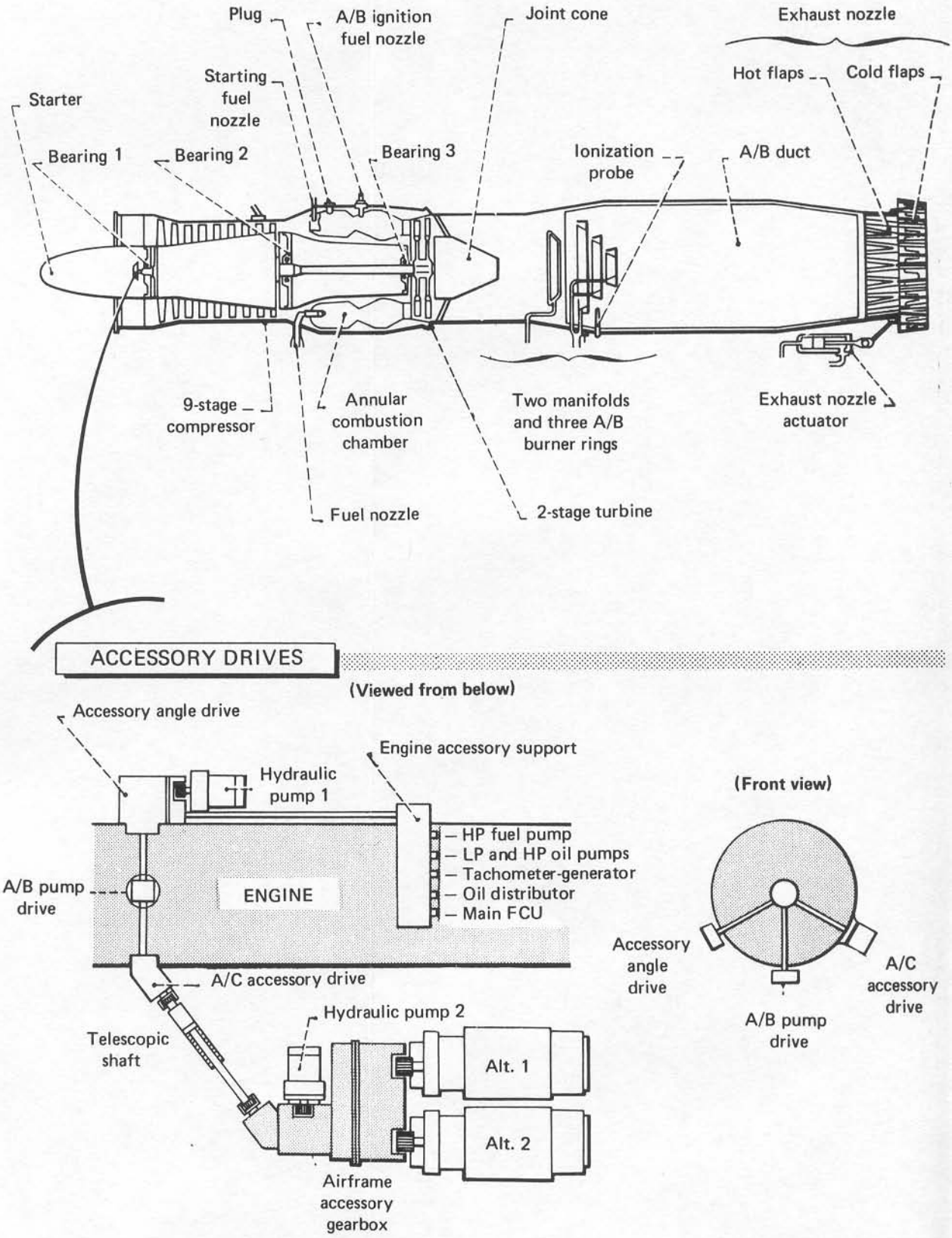


FIGURE 1 – ATAR 9K 50 JET ENGINE

FIGURE 3 – ENGINE CONTROLS AND INDICATORS

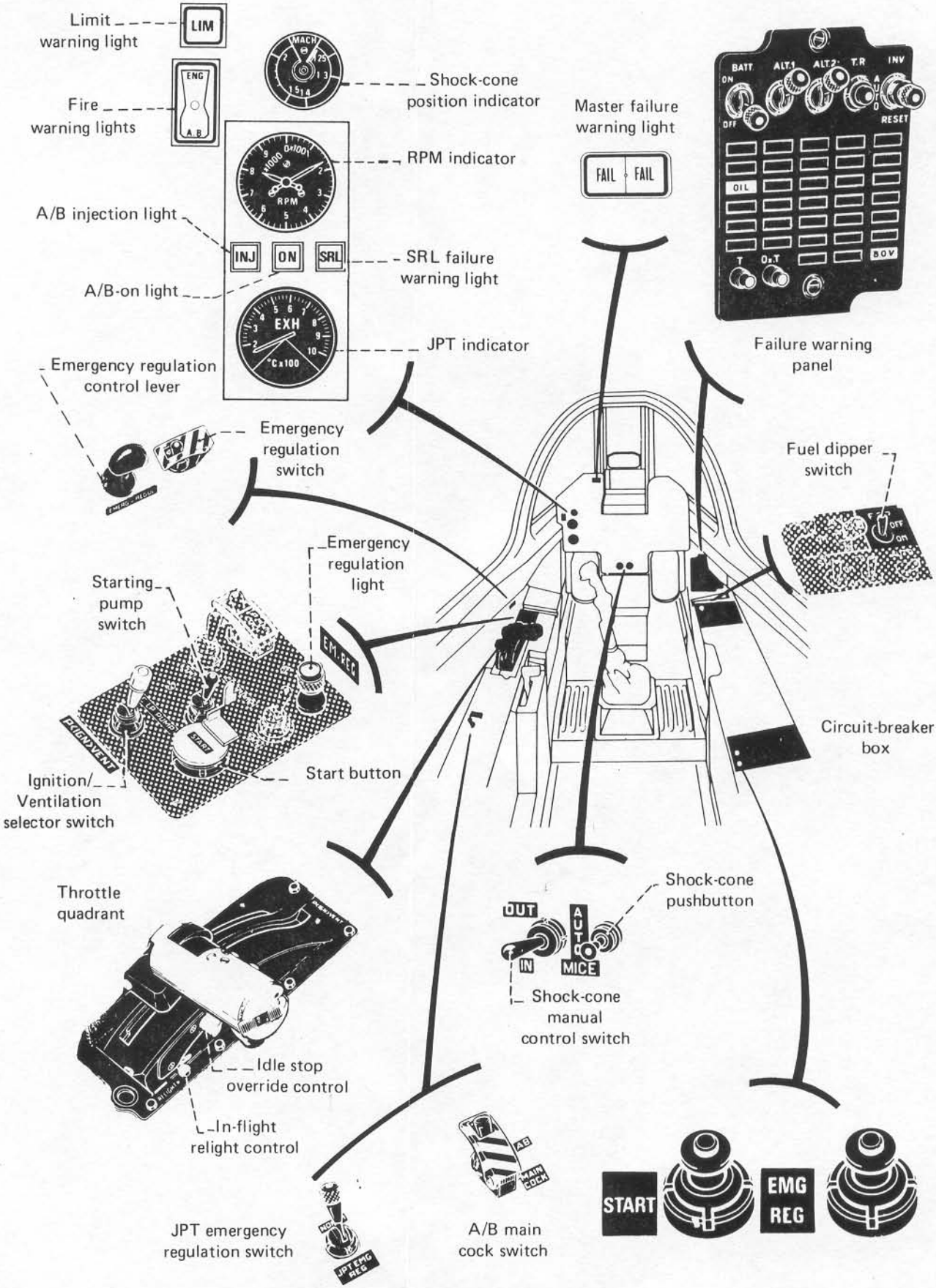


FIGURE 3 – ENGINE CONTROLS AND INDICATORS

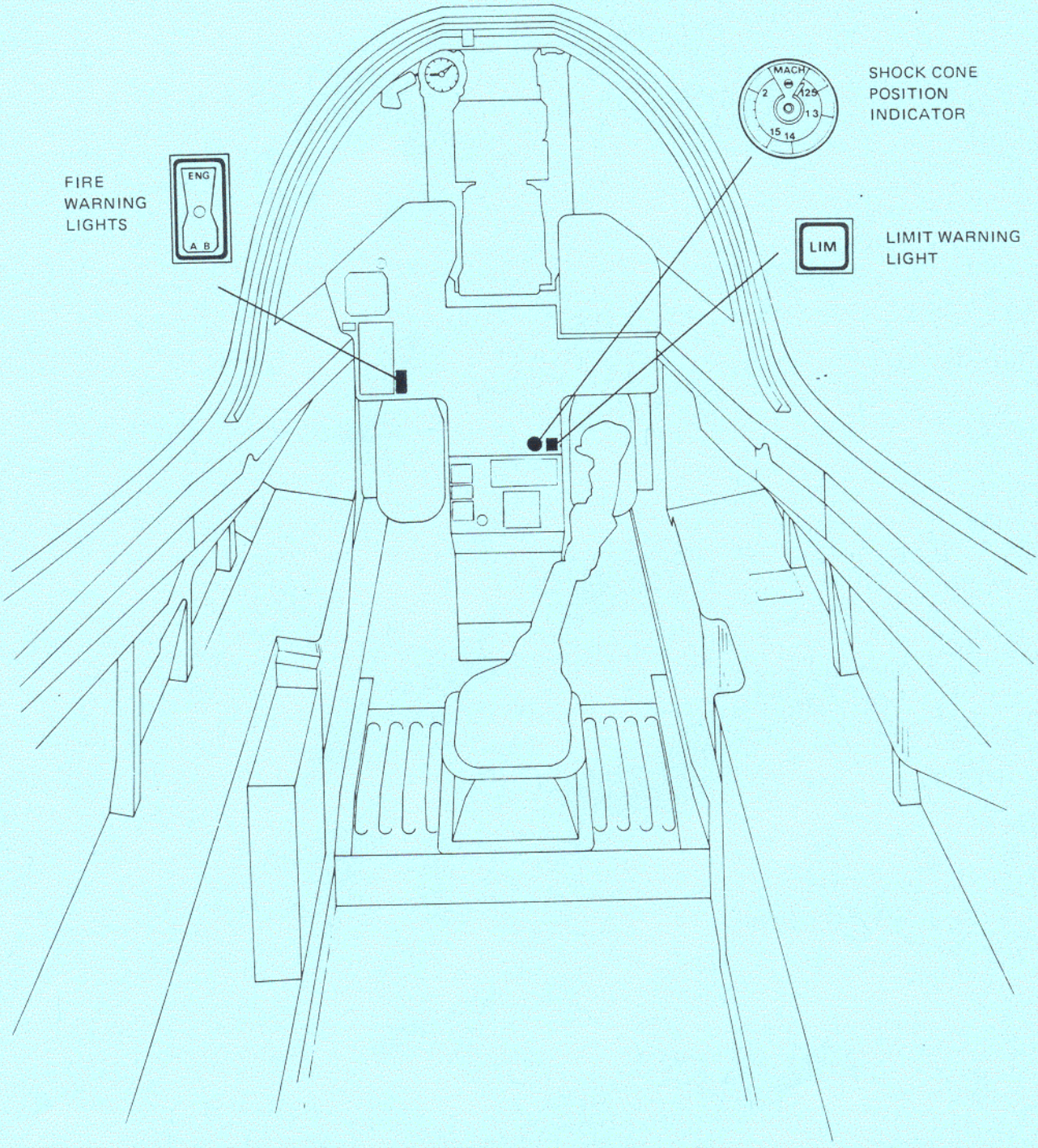


FIGURE 3A – ENGINE CONTROLS AND INDICATORS
(POST/SAAF/MOD/MIR/282)

1,30 - HYDRAULIC SYSTEM

1, 30 - HYDRAULIC SYSTEM

1, 30. 1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
HYDRAULIC SYSTEMS 1 AND 2	Dual hydraulic pressure gauge	2 scales	"1 SERVO 2" "ANC - Em. B"
	Hydraulic pressure selector switch	2 positions	
	Circuit-breaker	"HYD. P"	
	HYD.1 HYD.2 lights	Amber	
ELECTRO-PUMP	Electro-pump switch	2 positions Off - Auto	
	E.P. light	Red	8 sec. time-delayed illumination
	EMG.HYD light	Red	
	Circuit-breaker	"EL PUMP"	
STICK UNCOUPLE			See autopilot

1,30.2 - DESCRIPTION

The generation and distribution of hydraulic energy comprises two independent main systems of equal power and an emergency system.

1 - HYDRAULIC SYSTEM 1

This system consists of the following :

- a self-pressurized reservoir having a usable capacity of 9 litres (2. 0 Imp. gals - 2. 4 U. S. gals). This reservoir comprises a contact switch which electrically controls the ancillary shut-off valve when the level drops below 2. 6 litres (0. 6 Imp. gal - 0. 7 U. S gal)
- a self-regulating pump directly driven by the engine (rated pressure : 210 bar (3046 psi) ; rated flow $\geqslant$ 45 litres/min. (10 Imp. gals/min. - 12 U. S. gals/min.))
- a pressure switch controlling the illumination of the HYD.1 light on the failure warning panel
- two distinct sub-systems :

  - A servo-control sub-system in which :

    An accumulator with a non-return valve supplies :
    - barrel 1 of the servo-controls (stabilator, spoilers, rudder)
    - barrel 1 of the aileron servo-controls in case of system 2 failure
    - barrel 1 of the auxiliary servo-controls (pitch and roll)
    - the pitch ARTHUR
    - the releasable bellcranks (pitch, rudder).

    A pressure transmitter detects the pressure downstream of the accumulator and electrically operates the dual hydraulic pressure gauge (servo 1).

  - An ancillary sub-system :

    It is provided with a shut-off valve.
    It supplies :
    - the normal and emergency braking systems
    - the slat control system
    - the two flap actuating jacks
    - the airbrake control system
    - the shock-cone control system
    - the normal U/C control system.

    Two pressure transmitters detect the ancillary and emergency brake pressures for the dual hydraulic pressure gauge ("ANC - Em. B").

2 - EMERGENCY HYDRAULIC SYSTEM

Drawing fluid from the reservoir of hydraulic system 1, it supplies the servo-control sub-system of this system.

The emergency hydraulic system consists of the following :

- an electro-pump supplied by the main DC system ; it comes into operation automatically when a drop in pressure occurs in system 1 (rated pressure : 170 bar (2466 psi) ; rated flow : 8 litres/min. (1. 8 Imp. gals/min. - 2. 1 U. S. gals/min.))
- an accumulator with a non-return valve
- a pressure switch controlling the illumination on the failure warning panel of the EMG.HYD light + warning horn
- a pressure switch which ensures :
  - starting and stopping of the electro-pump
  - energization of the time delay relay controlling the illumination on the failure warning panel of the E.P. light + warning horn
  - a non-return valve on the junction with system 1.

1,30.4 - HYDRAULIC FAILURES

"ANC" PRESSURE

Pressure readings — Ancillaries = 0
Servo 1 = 210 bar (3046 psi)
with or without illumination of the HYD.1 light

The ancillary shut-off valve is closed (more or less serious leak).
2.6 litres (0.6 Imp. gal - 0.7 U.S. gal) remain in hydraulic reservoir 1. Valve shut-off preserves this fluid if the leak is in the ancillary sub-system.
Slats, flaps, airbrakes, shock-cones and normal U/C control system are lost.

HYD.1 light steady on

Pressure readings 140 bar (2031 psi) $\leqslant$ servo 1 $\leqslant$ 174 bar (2524 psi)
0 $\leqslant$ ancillaries $\leqslant$ 145 bar (2103 psi)

Failure of pump 1 regulation.
The electric pump supplies the pressure to the servo-control sub-system.
Use of the ancillaries may or may not be possible depending on the "ANC" pressure.
In the negative case : slats, flaps, shock-cones, airbrakes and normal U/C control system are lost.

HYD.2 light on

Pressure reading 0 $\leqslant$ servo 2 $<$ 145 bar (2103 psi)
Failure of pump 2 regulation.
If the pressure is 0 : barrel 2 of the servo-controls, emergency U/C extension and nose wheel steering are lost.

EMG.HYD light on + warning horn

Pressure readings : normal
The pressure in the emergency system is below 115 bar (1668 psi) or the pressure switch is defective.
The electric pump is off or defective. The emergency system is inoperative.

E.P. light on + warning horn

The electric pump has been operating for more than 8 seconds.

FIGURE 1 - HYDRAULIC SYSTEM

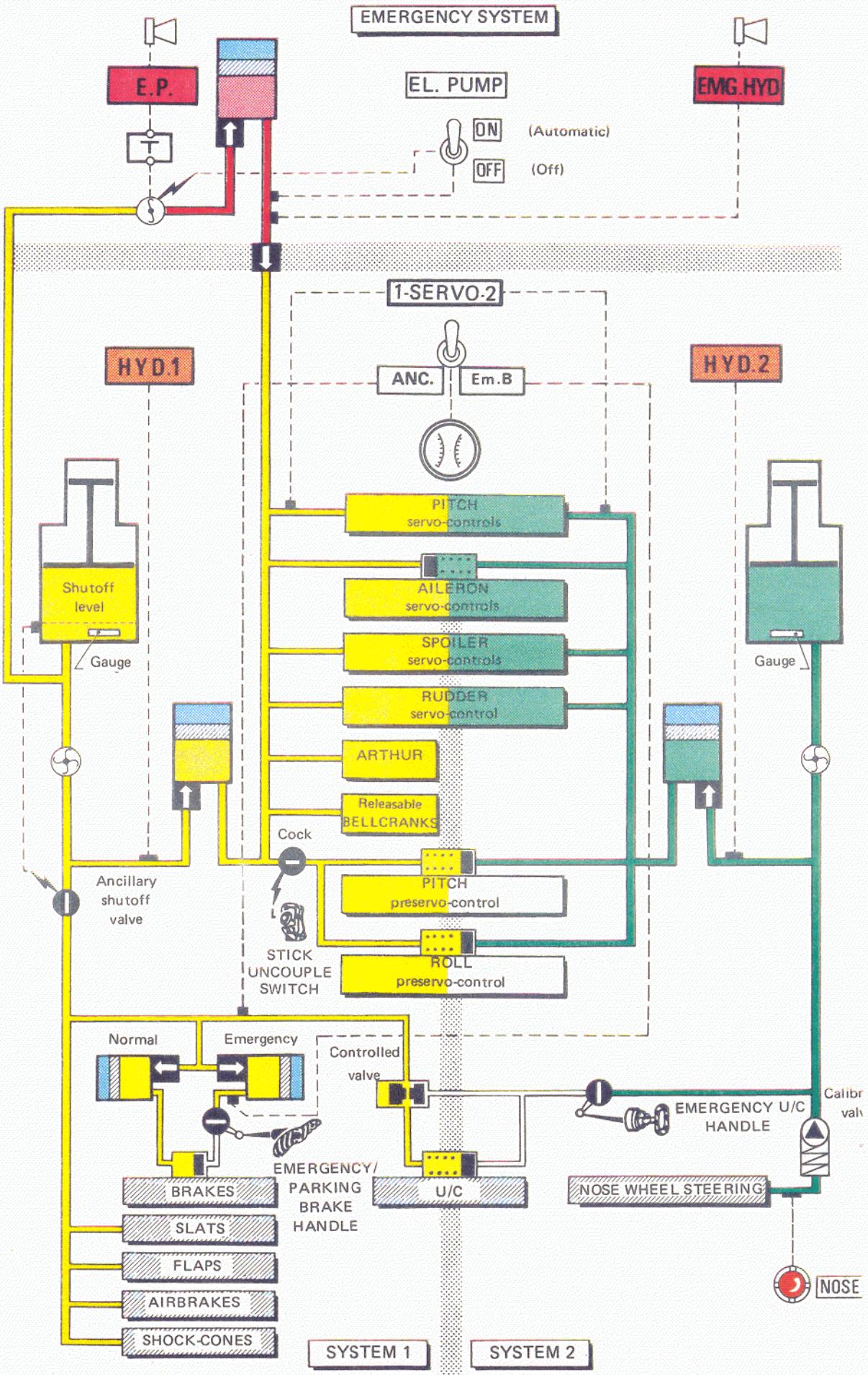


FIGURE 1 - HYDRAULIC SYSTEM

FIGURE 2 – HYDRAULIC SYSTEM
CONTROLS AND INDICATORS

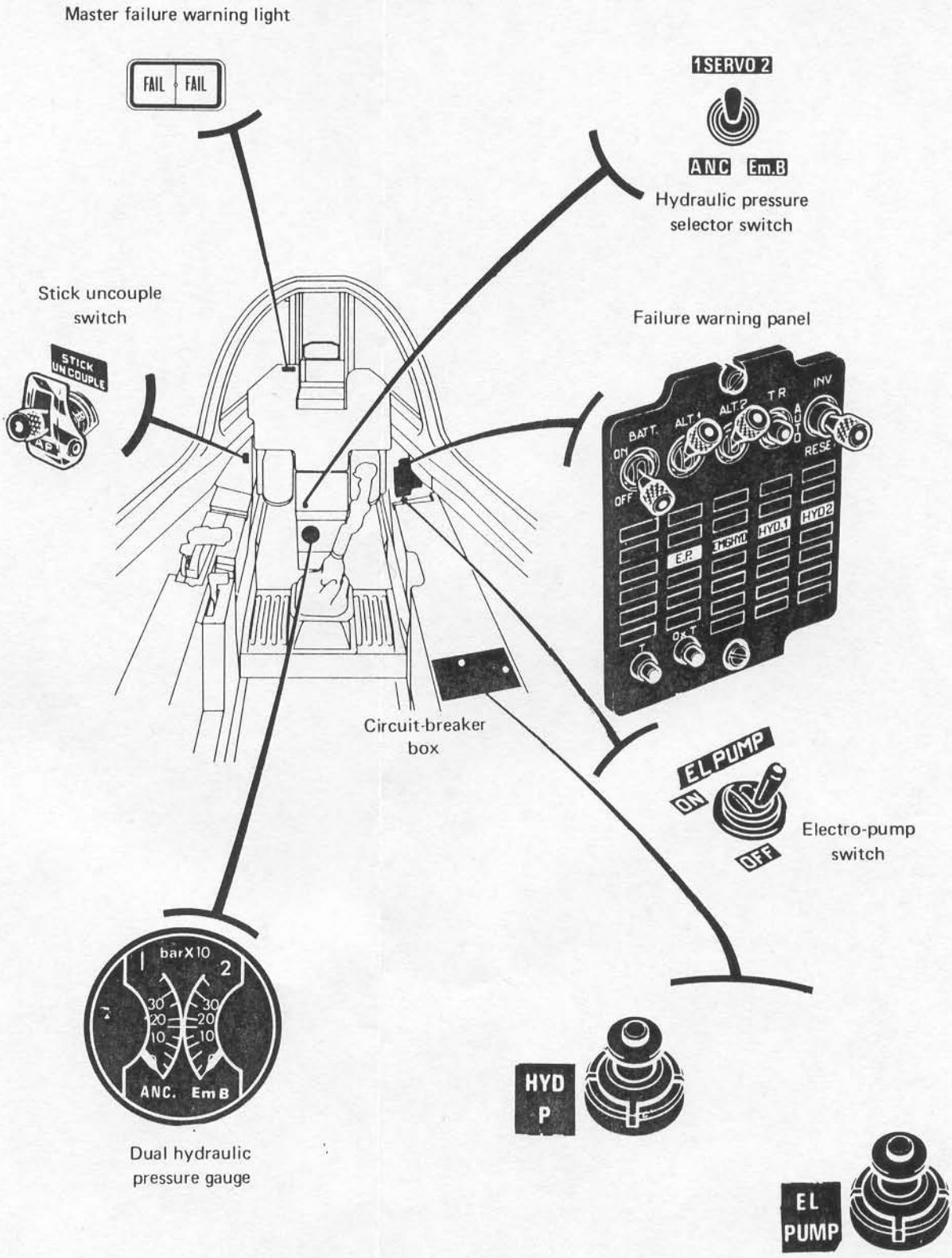


FIGURE 2 - HYDRAULIC SYSTEM CONTROLS AND INDICATORS

1,35 – FLIGHT CONTROLS AND FLYING AIDS

1,35 - FLIGHT CONTROLS AND FLYING AIDS

1,35.1 - PITCH - ROLL - RUDDER

1,35.1.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
PITCH	Control stick		
	Trim control switch	On control stick handgrip	Vertical movement
	Trim indicator	Horizontal bar "P"	
	Pitch switch	"PITCH" 2 positions	
	ARTHUR selector switch	3 positions "AUTO-HIGH-LOW"	
	Servo reset button		Common with rudder
	Stick uncouple switch	"STICK UNCOUPLE"	Guarded Common with roll
	Probe heating switch		Controls dash-pot heating
	PITCH ELEV ROLL. TRIM lights	Amber	
	Circuit-breaker	"PITCH TRIM"	
ROLL	Control stick		
	Trim control switch	On control stick handgrip	Lateral movement
	Trim indicator	Horizontal bar "R"	
	Stick uncouple switch	"STICK UNCOUPLE"	Guarded Common with pitch
	TRIM light	Amber	
RUDDER	Rudder pedals		
	Rudder trim control switch	3 positions with spring-loaded neutral position	
	Trim indicator	Vertical bar "Y"	
	Yaw/Anti-slip switch	3 positions "ANTI-SLIP" "YAW" "OFF"	
	Servo reset button		Common with pitch
	YAW RUD lights	Amber	

1,35.1.2 - GENERAL

The aircraft is controlled by moving the following control surfaces :

- two stabilators for pitch control, and for roll control in automatic damping mode
- two ailerons and two spoilers for roll control
- a rudder for yaw control.

Each control surface is actuated by an electro-hydraulic double barrel servo-control supplied by hydraulic systems 1 and 2.

The stabilator and rudder servo-controls are controlled either electrically torque motors, or mechanically by a linkage from the control stick and the rudder pedals.

The aileron and spoiler servo-controls are controlled mechanically only.

The stabilators also receive, electrically and over short travels, conventional pitch and roll damping commands (for roll control this is obtained by differential deflection, but in autopilot mode only). The rudder receives yaw damping commands in the same way. To prevent these commands from returning to the control stick and the rudder pedals, and to permit electrical operation of the servo-controls, the linkages are interrupted by releasable bellcranks.

For pitch and roll, the linkage includes two electro-hydraulic double barrel preservo-controls located near the control stick. They have a twofold purpose : to suppress the forces of the whole downstream linkage for the pilot, and to electrically receive commands from the autopilot.

Three flying modes are possible :

- Electro-hydraulic manual mode, or normal mode

In pitch and yaw, the pilot's commands are mechanically transmitted to the releasable bellcranks which are in released position. Then, they become electrical (potentiometer pickoffs) and are transmitted to the servo-control torque motors, as superimposed to the signals from the dampers.

The roll control is fully mechanical.

- Hydraulic manual mode

This is a down-graded mode which may take place after rudder or pitch channel failure. The releasable bellcrank(s) is locked and the servo-controls are mechanically actuated by the pilot ; the dampers are inoperative.

- Autopilot mode

The commands from the autopilot are electrically transmitted to the pitch and roll preservo-controls, the remainder operating as in normal mode. For the rudder, the commands directly reach the rudder servo-control.

1,35.1.3 - PITCH CHANNEL

This channel includes the following :

- the control stick
- an artificial feel system including :
  - an ARTHUR device
  - an AFU, or spring box
  - a trim actuator
  - a dash-pot jack
- a preservo-control
- an AMEDEE variable reduction ratio bellcrank
- two releasable bellcranks
- a dual solenoid-operated selector valve
- two stabilator servo-controls.

A - DESCRIPTION

Control stick :

It includes :

- a handgrip provided with the pitch and roll trim control and the autopilot disengage lever and disconnect trigger
- a body assembly actuating the linkage.

Preservo-control

Double barrel servo-control. Barrel 1 is normally supplied by hydraulic system 1 (SERVO line) ; it is controlled mechanically in normal flying mode and electrically (torque motor) in autopilot mode.
In this case, the input bellcrank is locked to the preservo-control ; the linkage is therefore driven by the latter and the control stick follows. However, two safety microswitches on the preservo-control body permit autopilot overpowering in case of excessive force applied to the control stick by the pilot.
Barrel 2 is supplied by hydraulic system 2, but only in case of hydraulic system 1 and emergency hydraulic system failure, or on pilot's action (stick uncouple switch).
This is performed by a solenoid valve actuating a dual feed valve, and permits a possible jamming of barrel 1 to be corrected. In this case, the autopilot is no longer usable.

AMEDEE variable reduction ratio bellcrank

This bellcrank is used to render the control less sensitive near the neutral position (low altitude high speed flight). For example, a 35 mm control stick movement is necessary for a 1° stabilator deflection around the neutral position, but only 5 mm is required in the full up position.

Releasable bellcranks

Purpose : to override the linkage during electro-hydraulic operation of the servo-control (normal mode) by authorizing a limited deviation between the control stick position and the control surface position ; this deviation is necessary to superimpose the damping command signals.
If an erratic electrical command signal leads to overriding the bellcrank, limit switches instantaneously cause locking without noticeable jerk.
The bellcrank is provided with three arms hinged about the same bolt attached to the structure :

A : arm connected to the pilot's linkage
B : arm connected to the servo-control selector valves
C : arm connected to the servo-control body and actuating the dual position pickoff.

Arm B can be hydraulically locked to or unlocked from arm A (locking pin).
Safety microswitches mounted on arm A and actuated by arm B define two deflection range of $\pm$ 3° and $\pm$ 1°30'.
The unlocking control and the deflection limit are controlled by a dual solenoid-operated selector valve.
The releasable bellcrank is fitted with a dual differential position pickoff, with its body integral with arm A, and its lever connected to arm C. This pickoff is used to slave the stabilator servo-control.

Dual solenoid-operated selector valve

This selector valve permits hydraulic power supply of the releasable bellcranks and is used only during operation of the servo-controls in electrical control mode.
Inside the body of the unit are two solenoid valves, an accumulator, a pressure relief valve and a pressure switch.
When energized, solenoid valve 1 permits passage of the pressure fluid to the lock of arm A, thereby unlocking the latter from arm B.
Solenoid valve 2 is slaved to the aircraft speed (air data computer).
When energized, it permits the moving stops to be overriden ; thus, the large deflection configuration is obtained.
When solenoid valve 2 is not energized, the hydraulic pressure is applied to the two moving stops, then authorizing only a small deflection of arm B relative to arm A.
The nitrogen charged accumulator constitutes a power reserve permitting operation of the bellcrank in case of system 1 and emergency system failure (three to five actuations approximately), with the solenoid valve energized.
The pressure switch permits operation of the servo-controls in electrical control mode. If the system pressure and the accumulator pressure drop, the pressure switch cuts off the electro-hydraulic operation of the servo-controls which then operate in mechanical control mode.

- Autopilot mode

As soon as the autopilot is engaged, the following occur simultaneously :

- control of the main selector valve of the preservo-control by the electrical torque motor, which renders the control stick integral with the preservo-control (locking of the input bellcrank)
- operation of the automatic trim function.

The signals from the autopilot passing through the flying aids are transmitted to the torque motor. The preservo-control moves and drives the control stick and the pitch linkage up to the releasable bellcranks ; then the operation is the same as in normal flying mode.
The trim actuator in automatic operating mode provides zero force of the AFU at any time whatever the movement imparted to the preservo-control.

Switching to manual control

Switching from automatic control to manual control may be due to either :

- a temporary disconnection or a voluntary cutout of the autopilot by the pilot, or
- operation of one or more safety devices in case of failure of the hydraulic or electronic circuits.

As soon as the autopilot is switched off, the electrical torque motor is no longer hydraulically activated, and the control stick mechanically controls the main selector valve, the input bellcrank being unlocked.

NOTE : (1) Since the autopilot signals are transmitted to the electro-hydraulic barrel of the preservo-control, it is possible to switch to manual control by cutting off the hydraulic supply to barrel 1 through the stick uncouple switch. The dual valve then automatically supplies barrel 2 (directly controlled by the control stick) and the hydraulic safety devices cut off the autopilot.

(2) It is also possible to cause the autopilot to be cut out by an abrupt jerk on the control stick, thereby causing operation of one of the safety microswitches controlled by the preservo-control bellcrank.

(3) In case of failure of the autopilot, the preservo-control switches to the mechanical mode, the AP light illuminates on the failure warning panel and the warning horn operates.

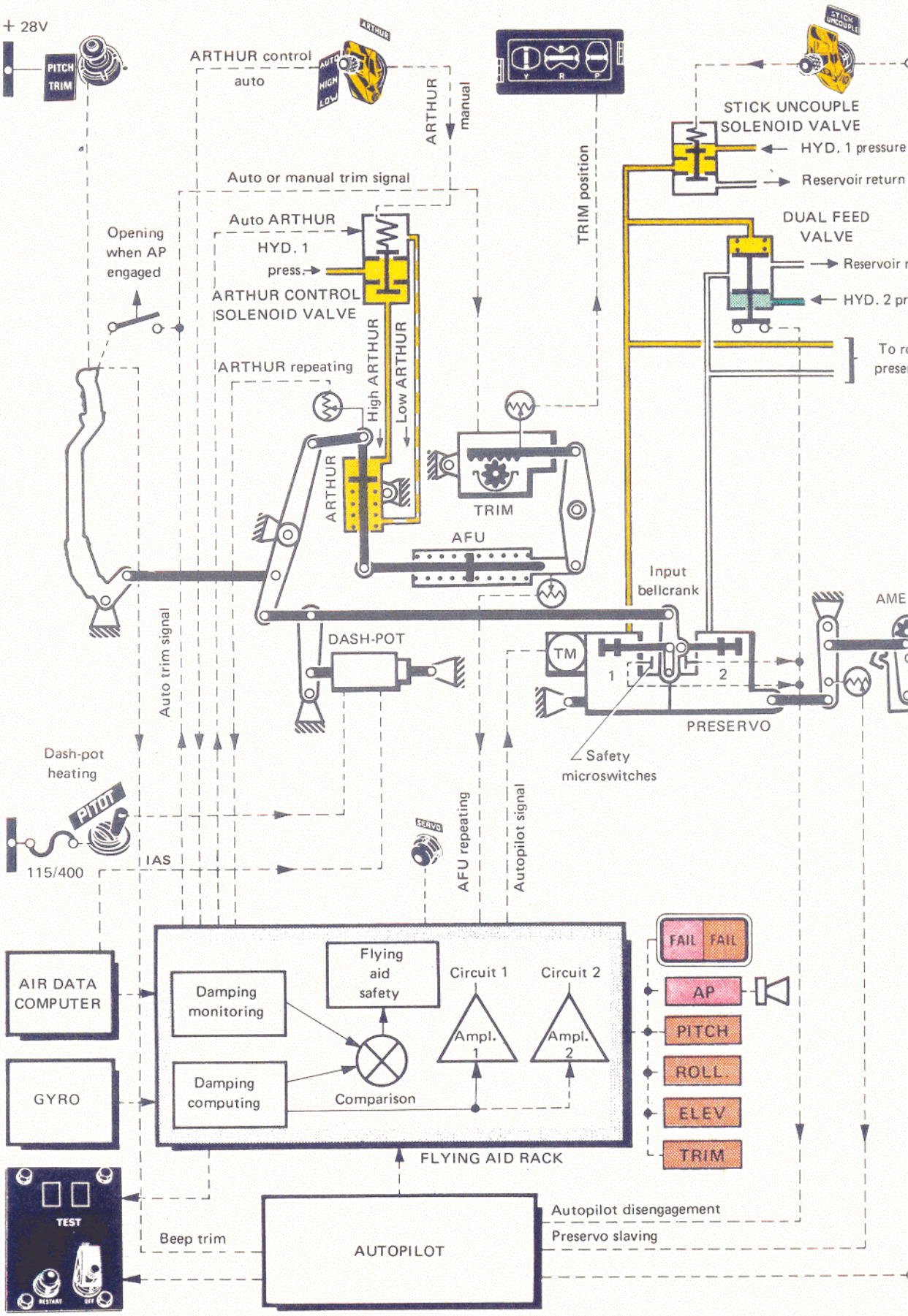
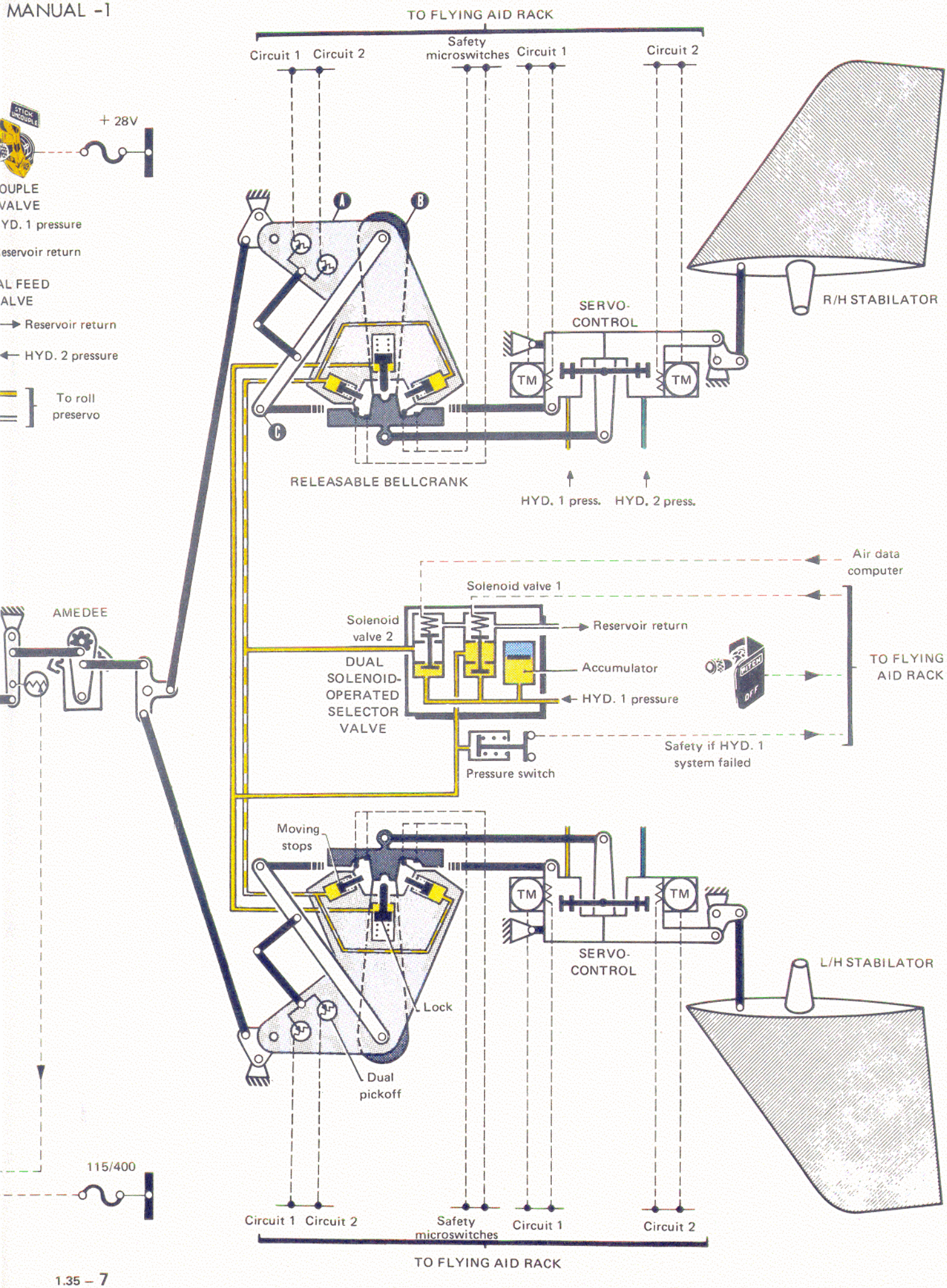


FIGURE 4 – PITCH CHANNEL


TO FLYING AID RACK
Circuit 1
Circuit 2
Safety microswitches
Circuit 1
Circuit 2
+ 28V
STICK UNCOUPLE
OUPLE
VALVE
YD. 1 pressure
eservoir return
AL FEED
ALVE
Reservoir return
HYD. 2 pressure
To roll preservo
A
B
C
SERVO-CONTROL
TM
TM
R/H STABILATOR
RELEASABLE BELLCRANK
HYD. 1 press.
HYD. 2 press.
Air data computer
Solenoid valve 1
Solenoid valve 2
Reservoir return
DUAL SOLENOID-OPERATED SELECTOR VALVE
Accumulator
HYD. 1 pressure
MIXED
OFF
TO FLYING AID RACK
Safety if HYD. 1 system failed
Pressure switch
AMEDEE
Moving stops
TM
TM
SERVO-CONTROL
L/H STABILATOR
Lock
Dual pickoff
115/400
Circuit 1
Circuit 2
Safety microswitches
Circuit 1
Circuit 2
TO FLYING AID RACK

1,35.1.4 - ROLL CHANNEL

The roll channel includes the following :

- the control stick
- an AFU
- a preservo-control
- a trim actuator for each aileron
- a spring rod for each aileron and each spoiler
- a servo-control for each aileron and each spoiler.

A - DESCRIPTION

Control stick (See para. 1,35.1.3)

AFU

The AFU only consists of a triple gradient spring box mounted in parallel in the linkage between the control stick and the roll preservo-control.

Preservo-control

The roll preservo-control is the same as the pitch preservo-control (See para. 1,35.1.3).
The function of the dual feed valve applies to two preservo-controls.
If the pilot has to act on the stick uncouple solenoid valve, circuit 1 is cut off at both preservo-controls and they are supplied by circuit 2.
The electrical input is used in the same way in autopilot mode.
There is a dual output position pickoff used for feedback and automatic trim function.

Roll trim actuators

The trim actuators are used to change the aileron linkage length without acting on the spoiler linkage thanks to the spoiler spring rod.
This feature prevents permanent deflection of the spoilers.
Each trim actuator is provided with three microswitches : two travel limit microswitches and one mean position microswitch which is used to synchronize the two actuators each time one of them is zeroed.
On each trim actuator, a potentiometer transmits the trim position to the indicator.
The trim operation may be either manually or automatically controlled. In case of automatic trim failure, the autopilot channel safety device illuminates the **TRIM** light without affecting the autopilot or suppressing the trim function.

Aileron spring rod

This rod provides for full spoiler deflection when the aileron servo-control is in mechanical abutment or operating at its maximum capacity.

Aileron servo-control

This is a double barrel servo-control. During normal operation, it is supplied only by hydraulic system 2 through barrel 2 so as to limit the aileron deflection (by saturating the servo-control) at high speed (structural stresses when wing tip missiles are carried).
Supply of barrel 1 (hydraulic system 1) is obtained automatically in case of failure of hydraulic system 2.

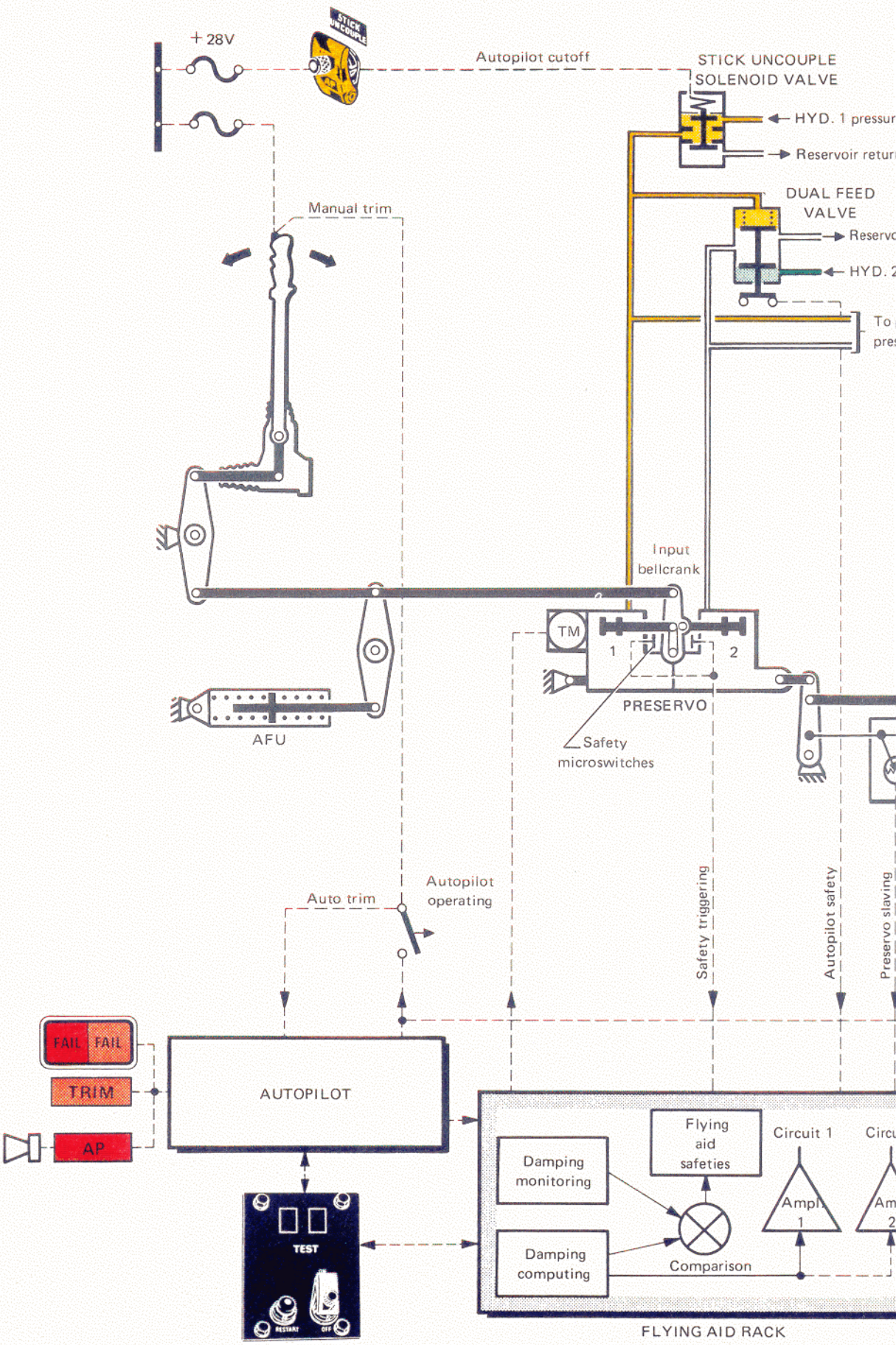


FIGURE 5 – ROLL CHANNEL

PLE
LVE

YD. 1 pressure

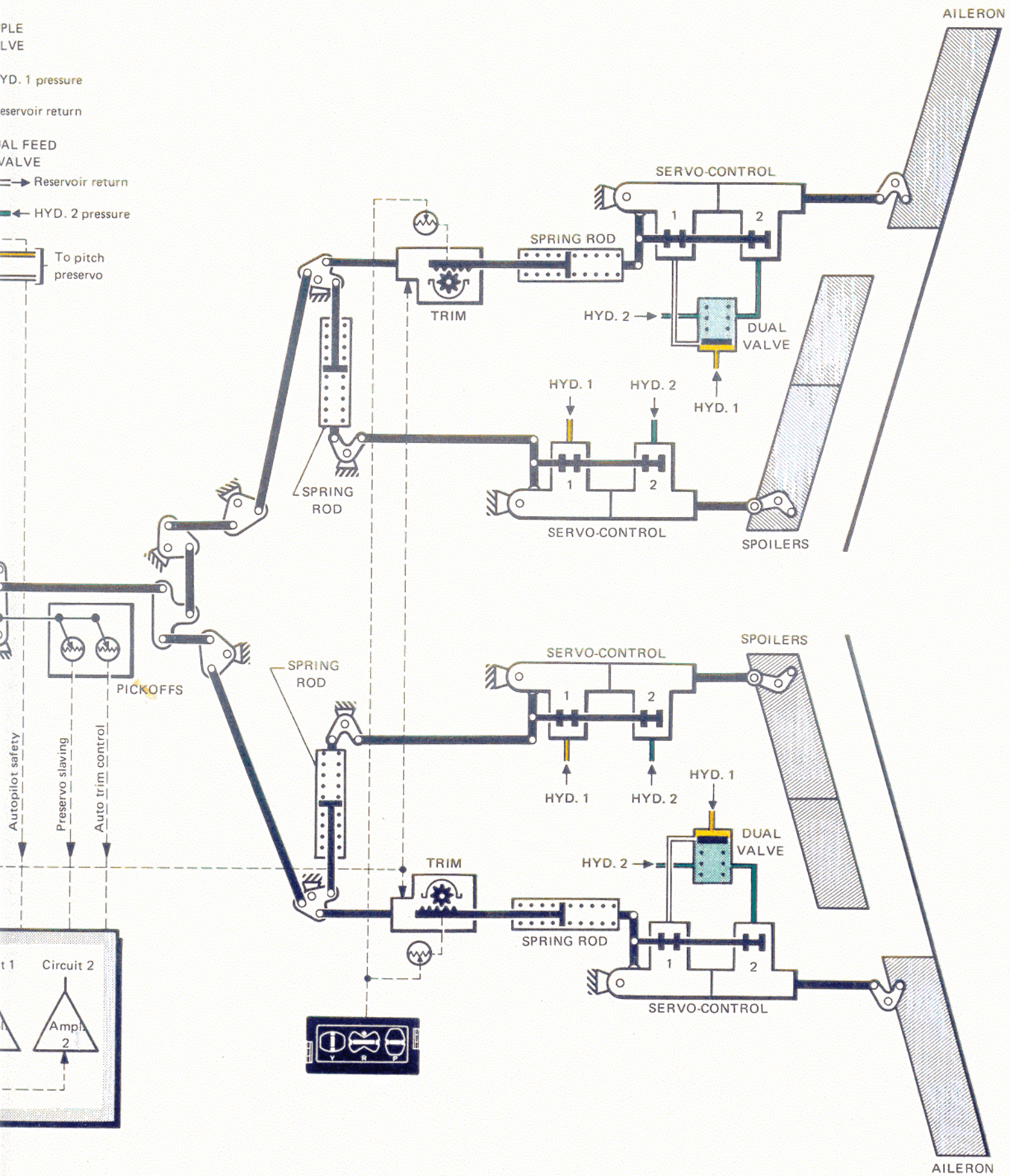
eservoir return

AL FEED
VALVE

Reservoir return

HYD. 2 pressure

To pitch
preservo



1,35.1.5 - RUDDER CHANNEL

The rudder channel includes the following :

- rudder pedals
- two steel cables routed in the upper section of the fuselage up to the fin root
- a fin linkage including a double quadrant
- an AFU
- a trim
- a releasable bellcrank
- a servo-control.

A - DESCRIPTION

Rudder pedals

The rudder pedals are used to control :

- rudder
- normal braking
- nose wheel steering.

An adjustment mechanism is used to adjust the pedal position to the pilot's size.

Double fin quadrant

It essentially consists of two diametrically opposed quadrants pivoted about a common pin.
This assembly is vertically mounted at the bottom of the fin.
The quadrant extends in an arm which transmits the movement to the releasable bellcrank and the servo-control through a rod.
On the other hand, between the two main quadrants, a small lever arm connects this assembly to the AFU.

AFU

Single gradient spring box consisting of :

- a cylindrical body, one end of which is connected to the trim actuator
- a rod sliding in the cylinder, with the end connected to the double control quadrant
- a safety microswitch attached to the outside of the body and actuated by the rod. This microswitch cancels the anti-slip function as soon as a linkage movement initiated by the pilot causes the AFU to leave its zero force position.

Rudder trim actuator

Its function is to displace the zero force position of the AFU.
Internally, it is fitted with two travel limit microswitches and a potentiometer.
The potentiometer transmits the trim actuator position to the indicator.
The trim actuator is controlled by the rudder trim control switch.
The trim operation can be manually or automatically controlled when the anti-slip function is in operation.

Releasable bellcrank

The releasable bellcrank is similar to those of the pitch control but it allows only one deflection range (7°45') throughout the flight envelope.

Releasable bellcrank solenoid-operated selector valve

This selector valve allows or not the hydraulic system 1 pressure to the releasable bellcrank.
It is supplied by the electrical circuit 1 or 2 upon closing of the Yaw/Anti-slip switch.
Energized position : hydraulic pressure is admitted and the bellcrank arms are unlocked.
De-energized position : hydraulic pressure is returned to the reservoir and the bellcrank is locked.

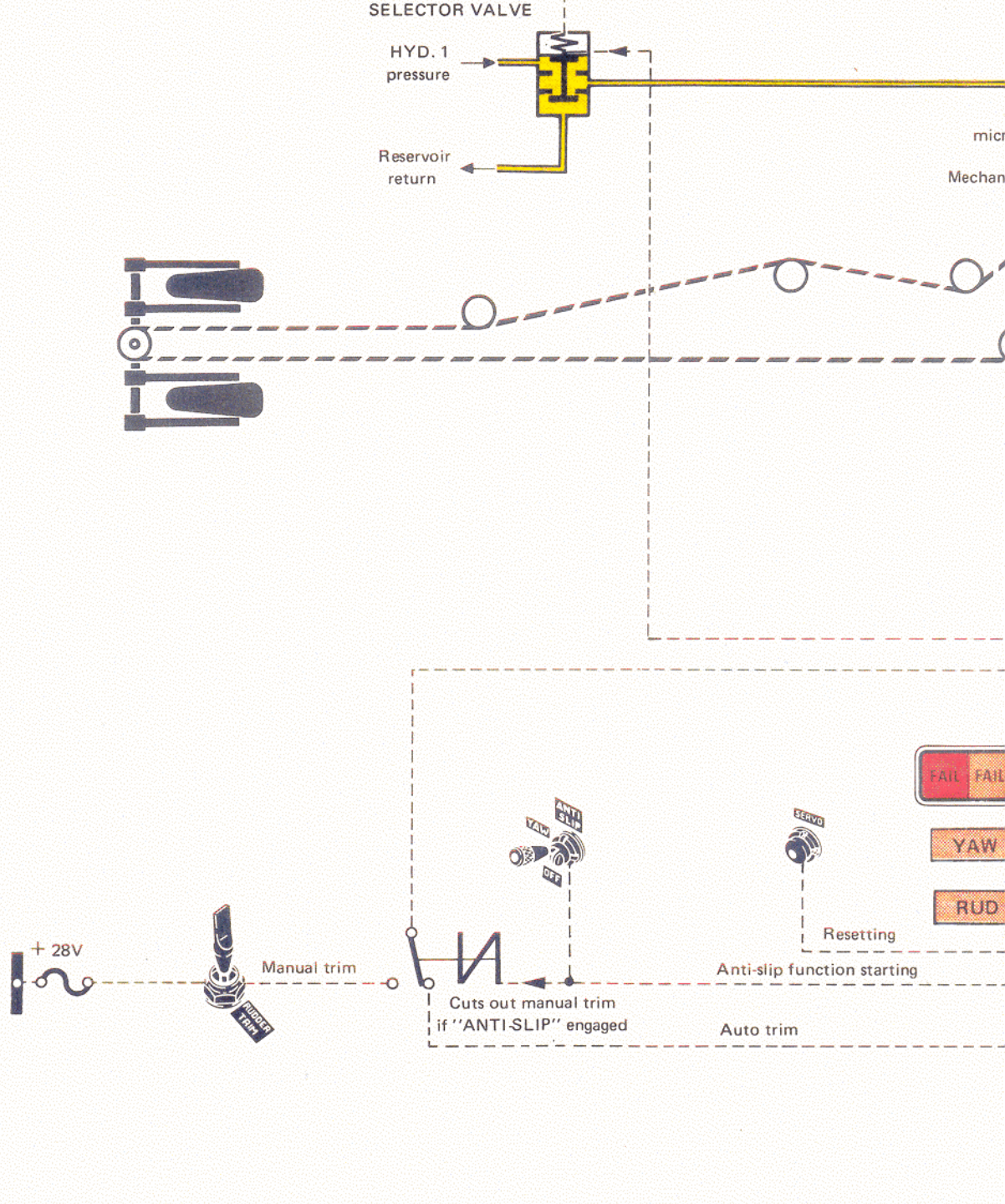
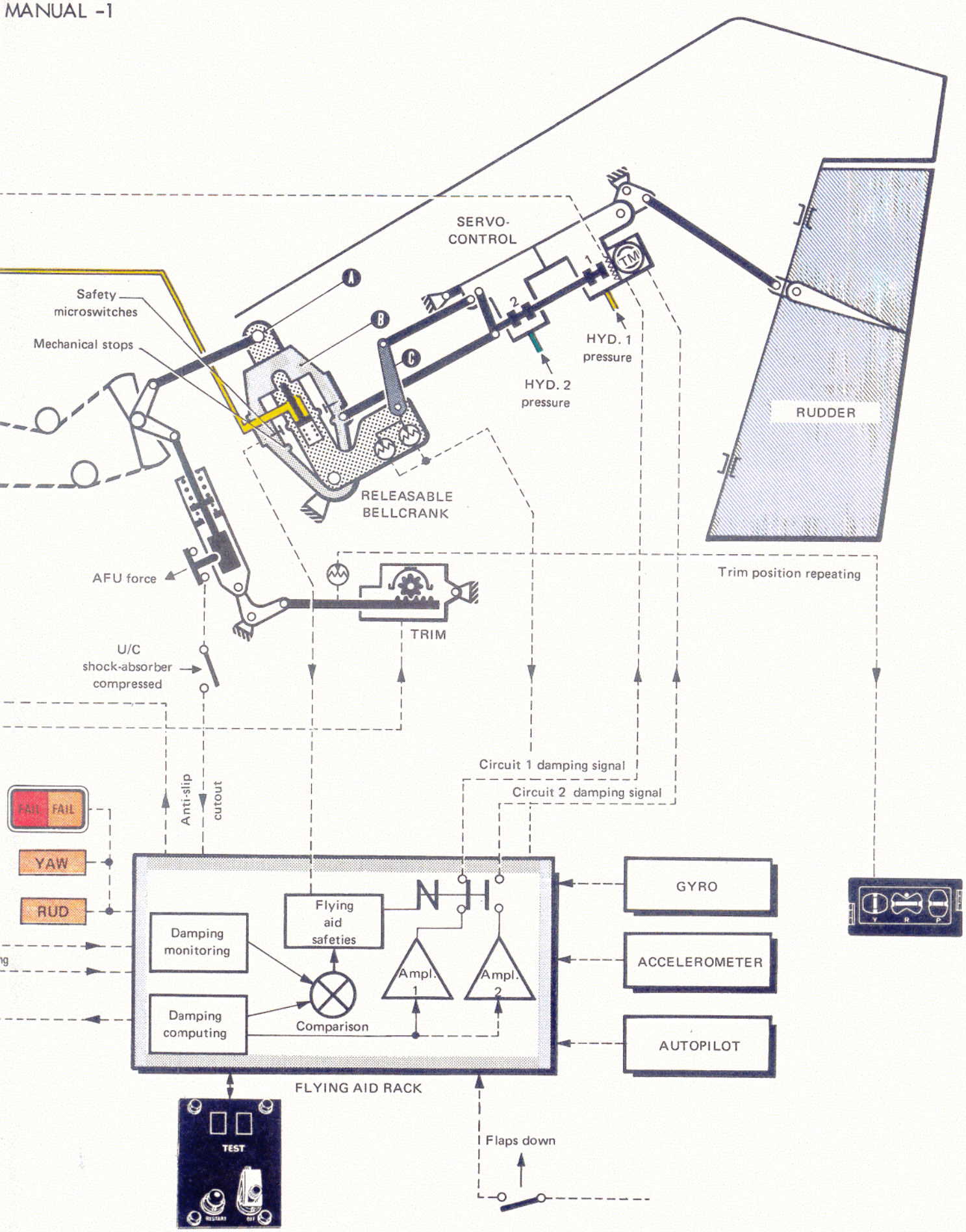


FIGURE 6 – RUDDER CHANNEL


SERVO-
CONTROL
A
B
C
1
2
TM
Safety
microswitches
Mechanical stops
HYD. 1
pressure
HYD. 2
pressure
RUDDER
RELEASABLE
BELLCRANK
AFU force
TRIM
Trim position repeating
U/C
shock-absorber
compressed
Anti-slip
cutout
Circuit 1 damping signal
Circuit 2 damping signal
FAIL
FAIL
YAW
RUD
Damping
monitoring
Flying
aid
safeties
Damping
computing
Comparison
Ampl.
1
Ampl.
2
GYRO
ACCELEROMETER
AUTOPILOT
FLYING AID RACK
TEST
RESTART
OFF
Flaps down

1, 35. 1. 6 - FAILURES

ELEV light on

Failure of the first electrical pitch circuit.

Pitch control operation in electrical mode on the second circuit.

PITCH + ROLL. + ELEV lights on

- "PITCH" switch "OFF", or
- Failure of both electrical circuits, or
- Failure of the pitch damper, or
- Hydraulic failure.

Pitch control operation in mechanical mode.
The autopilot can no longer be used.

RUD light on

Failure of the first electrical rudder circuit.

Rudder control operation in electrical mode on the second circuit.

YAW + ROLL. + RUD lights on

- "YAW" switch "OFF", or
- Failure of both electrical circuits (or torque motor), or
- Failure of the yaw damper, or
- Hydraulic failure.

Rudder control operation in mechanical mode.
The autopilot can no longer be used.

ROLL. light on

Failure of the roll damper.
The autopilot can no longer be used.

REMARK : Cutting out of the yaw damper automatically cuts out the roll damper.

YAW + PITCH + ROLL. + ELEV + RUD lights on

Complete flying aid failure.
Permanent return to mechanical mode.

Failure of the ARTHUR

This failure is generally due to a failure of the air data computer or its output multipliers. It results in abnormal pitch forces, which the pilot can rectify by using the ARTHUR selector switch.

NOTE : Abnormal pitch feels can also be due to dash-pot failure.

FIGURE 7 – FLIGHT CONTROL SYSTEM CONTROLS AND INDICATORS

CATORS

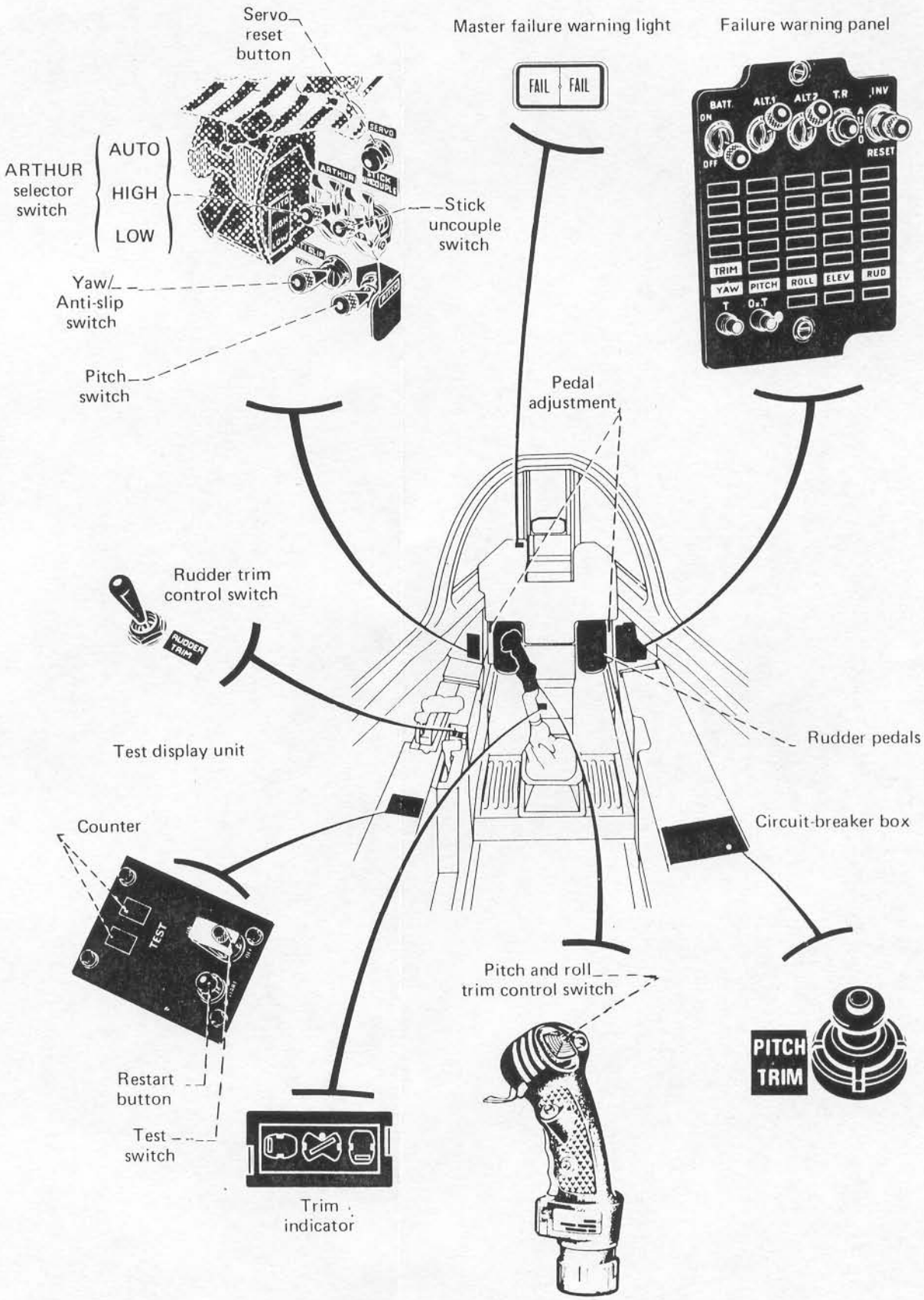


FIGURE 7 - FLIGHT CONTROL SYSTEM CONTROLS AND INDICATORS

1, 35. 2 - AUTOPILOT

1, 35. 2. 1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
BASIC FUNCTIONS	Master control	"AP" lighted pushbutton, blip operated, amber/green	Steady amber = autopilot engaged and connectable Flashing amber = autopilot disengaged and not connectable Green = autopilot connected
	Disconnect trigger		Pressed = disconnection Released = connection
	Pitch and roll trim control switch	Spring-loaded neutral five-position control switch	Changes heading or attitude when blipped
	AP light	Red	Autopilot failure
	TRIM light	Amber	Trim failure in auto mode
SPECIFIC FUNCTIONS	Altitude hold control	"ALT" lighted pushbutton, blip operated, green/red	Green = functioning 5-sec. flashing red = loss of function Steady red = total loss of autopilot
	VOR or TACAN course or ILS localizer beam intercept and hold control	"R" lighted pushbutton, blip operated Amber Green Red	Amber = standby for interception Green = course holding Steady red = excessive course deviation 10-sec. flashing red = loss of function
	ILS glide slope intercept and hold control	"G" lighted pushbutton, blip operated Amber Green Red	Amber = standby for interception Green = glide slope holding Steady red = excessive glide slope deviation 10-sec. flashing red = loss of function
	Roll trim control switch	Spring-loaded neutral five-position control switch	Selects heading (read through navigation indicator moving index) when continuously actuated
GENERAL DISENGAGEMENT	Autopilot disengage lever		Acting on lever causes amber flashing of "AP" light. A second action causes light extinction
	Master control		Blip action on "AP" lighted pushbutton
	Control stick		Stick force temporarily illuminates AP light and causes amber flashing of "AP" light
DISENGAGEMENT OF SPECIFIC FUNCTIONS	Disconnect trigger		Autopilot in basic function standby
	Respective lighted pushbuttons		"ALT", "R" or "G"
	Pitch and roll trim control switch		According to blip action disengages "ALT", "R" or "G"
EMERGENCY DISENGAGEMENT	Stick uncouple switch	2 positions Guarded	Illuminates AP light

1,35.2.2 - GENERAL

The autopilot, without overpowering mode, is essentially a computer generating corrective commands adapted to flight conditions (Hp and M). It receives information from the gyro centre, the internal altitude control and the auxiliary servo-control position pickoffs. It transmits information in the form of electrical commands to the torque motors of barrels 1 of the pitch and roll auxiliary servo-controls through the flying aid unit.

The dampers remain in operation, but with different gains. A correlation between the roll rate and the position of the rudder comes into operation when the flaps are extended.

The aircraft is automatically trimmed in pitch (force detection at the AFU) and roll (cancellation of undesired spoiler extension through potentiometer detection on the control linkage). This feature allows smooth return to manual control.

In general, the autopilot operates by comparing the actual flight parameters to the parameters stored upon connection (attitude, heading holding or roll holding), or to those defined on engagement of the steering modes (altitude, radio beacon course).

B - Selected heading intercept and hold

From the moment the aircraft power system is on, the navigation indicator index is slaved to the fixed marker representing the lubber line. Upon connection, if the bank angle is smaller than 10°, the index synchronization system is cut off and the index is frozen relative to the lubber line. Actuating the roll trim control switch moves the index relative to the heading compass card and the autopilot returns the index and card assembly to the lubber line.

C - VOR or TACAN course intercept and hold

With the basic functions connected, with or without specific functions, depressing the "R" pushbutton causes it to illuminate (amber section) until interception of a VOR or TACAN course selected on the omnibearing and VOR/ILS-TACAN selector. (The flight path of the aircraft must be sharply convergent with the radio beam to be intercepted).
At the moment of interception of the beam, the green section of the "R" pushbutton comes on, indicating that the aircraft is effectively slaved to the radio course and that the selected heading function is disengaged. The navigation indicator index is again slaved to the lubber line.
The "R" function is automatically disengaged when the aircraft passes through the cone of silence of the beacon ; the autopilot is then in the heading hold mode.
Any action on the roll trim control switch after interception of the beam causes disengagement of the radio steering mode and extinction of the "R" pushbutton.

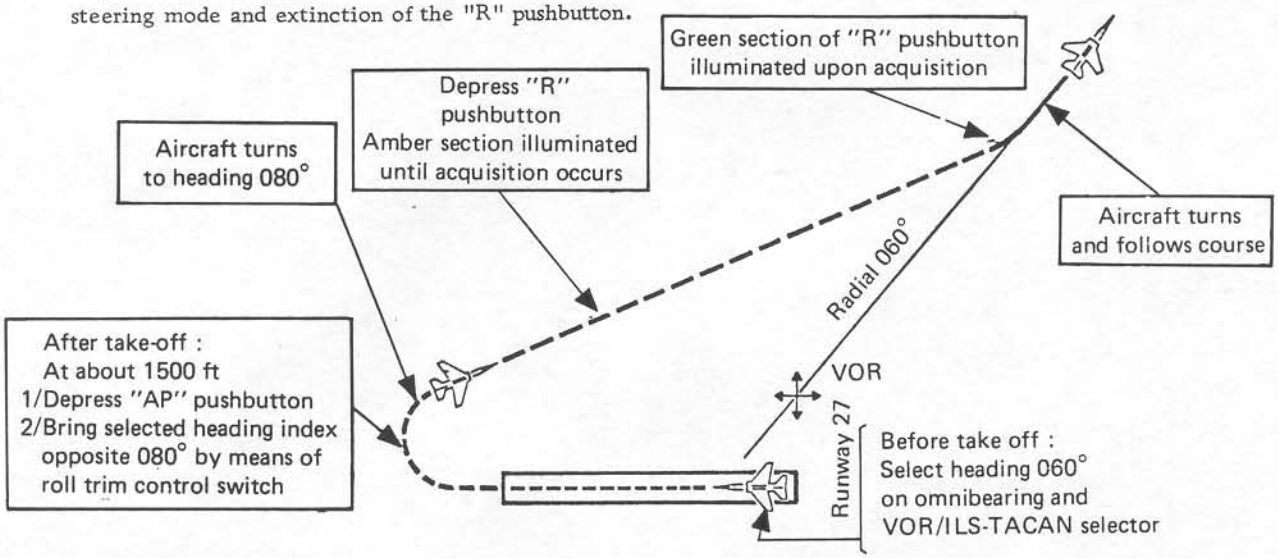

Green section of "R" pushbutton illuminated upon acquisition
Depress "R" pushbutton Amber section illuminated until acquisition occurs
Aircraft turns to heading 080°
Aircraft turns and follows course
Radial 060°
After take-off :
At about 1500 ft
1/Depress "AP" pushbutton
2/Bring selected heading index opposite 080° by means of roll trim control switch
VOR
Runway 27
Before take off :
Select heading 060°
on omnibearing and
VOR/ILS-TACAN selector

FIGURE 7 M – TYPICAL VOR RADIAL INTERCEPTION

D - ILS beam intercept and hold

With the basic functions connected, with or without specific functions, depressing the "R" and "G" pushbuttons causes them to illuminate (amber section) and permits interception of the LOC/GLIDE beams of an ILS (frequency selected on the VOR/ILS control unit) with the approach heading selected on the omnibearing and VOR/ILS-TACAN selector.
Interception of the localizer is indicated by the "R" pushbutton changing to green (index synchronization on lubber line). Interception of the glide path is indicated by the "G" pushbutton changing to green and the extinction of the "ALT" pushbutton (which flashes red for 5 seconds).
During the descent, the steering schedule is made proportional to the altitude by an information signal from the radio-altimeter.
Steady red lighted triangles on the "R" and "G" pushbuttons indicate deviations from the two ILS beams. They also indicate loss of function (whether voluntary or not) by flashing for 10 seconds.
Any action on the roll trim control switch and the "ALT" pushbutton after interception of the beams causes disengagement of the corresponding steering mode.

E - Action of BEEP trims on specific functions

- the roll BEEP trim disengages the "R" specific function with extinction of its pushbutton (the red section of "R" flashes for 10 seconds).
- the pitch BEEP trim disengages the "ALT" and "G" specific functions with extinction of their pushbuttons and illumination of the red section of "ALT" for 5 seconds and "G" for 10 seconds.

These functions can be brought back into service by action on the pushbuttons.

Action on the quick disengage lever extinguishes these lights (except for the master warning light). The autopilot is then ready to be returned to operation if the failure has disappeared, except in the case of an «autopilot monitor» failure.

- Autopilot engaged and disconnected :
  . all the interlocks prohibit reconnection, in particular if the aircraft is outside the connection envelope (angular velocities or attitude) ; reconnection is possible only after normal conditions are restored.

C - Monitoring Operation (Monitor failure)

Disagreement between the two logic circuits causes permanent unserviceability of the autopilot with illumination of the AP light accompanied by continuous illumination of the amber «AP» pushbutton light, continuous illumination of the red «ALT» pushbutton light and continuous illumination of the red excessive deviation lights.
This failure is indicated irrespective of the autopilot operating mode.

1,35.2.4 - FAILURES

AP light on + warning horn + amber «AP» flashing

Action of an interlock : the autopilot is disengaged.

If the failure disappears, the AP light goes out after 10 seconds.

TRIM light on

Malfunction of automatic pitch or roll trim.
Possibility of a jerk on disconnection or disengagement of the autopilot.

SPECIFIC FUNCTION FAILURES

Failures of these functions extinguish the corresponding light, except in the case of the altitude hold, the failure of which disengages the autopilot.

AP light on + amber «AP» steady on + red «ALT» steady on + red excessive deviation lights steady on

Autopilot monitor failure.
The autopilot is unserviceable (this failure is also indicated when the autopilot is disengaged or disconnected).

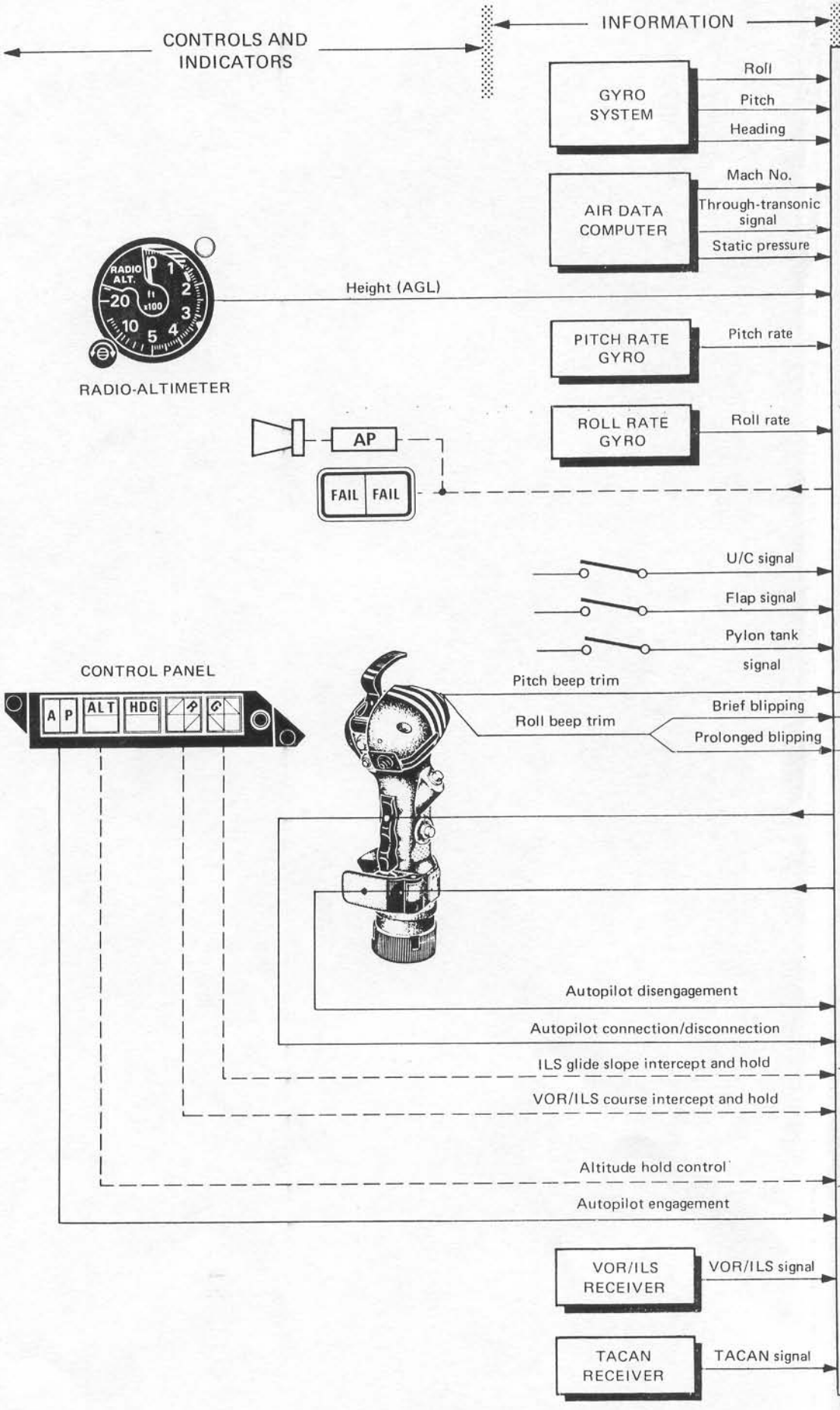


FIGURE 8 – AUTOPILOT FLIGHT CONTROL SYSTEM

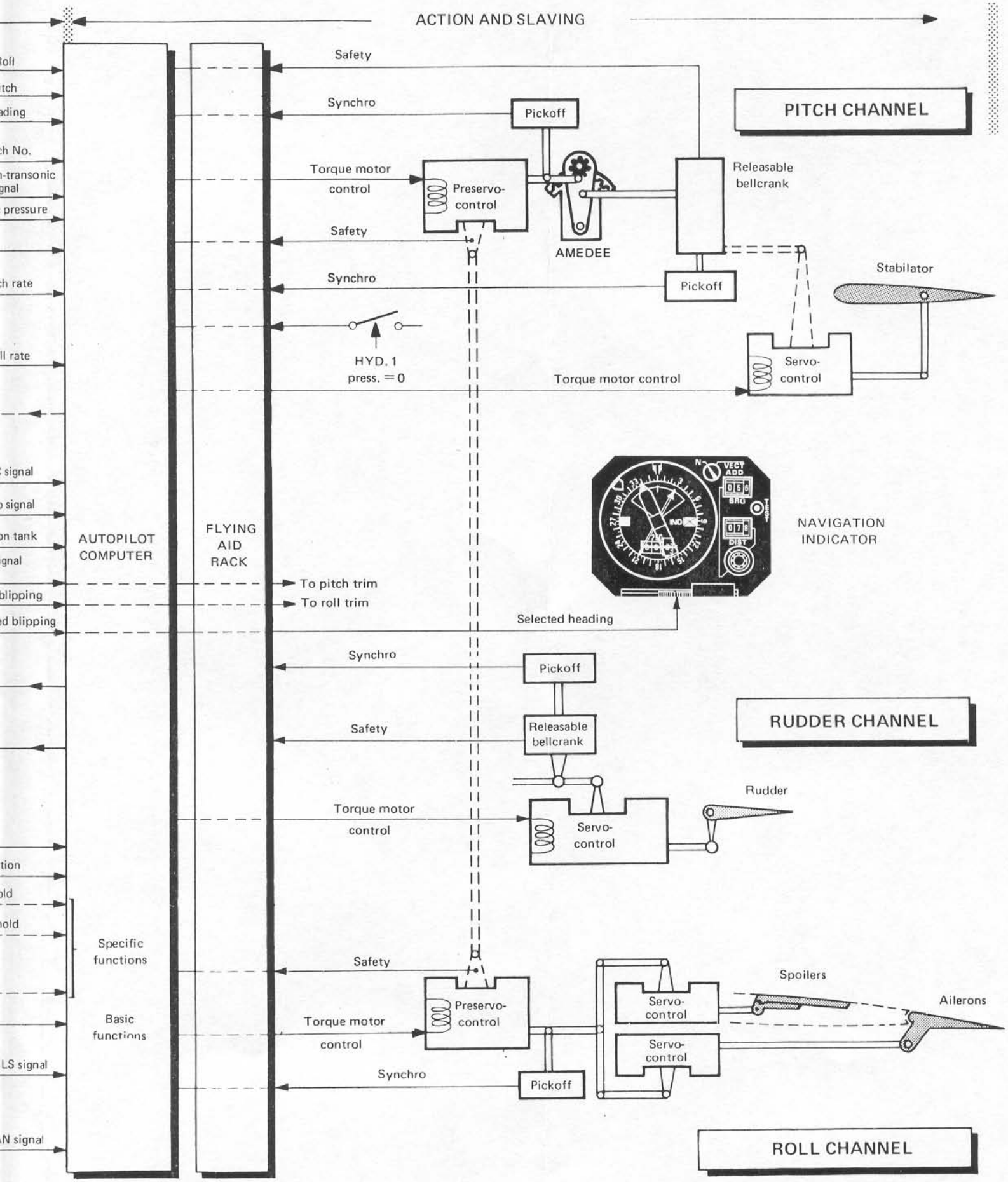

ACTION AND SLAVING
Safety
Synchro
Pickoff
PITCH CHANNEL
Torque motor control
Preservo-control
Releasable bellcrank
Safety
AMEDEE
Synchro
Pickoff
Stabilator
HYD. 1 press. = 0
Servo-control
Torque motor control
NAVIGATION INDICATOR
AUTOPILOT COMPUTER
FLYING AID RACK
To pitch trim
To roll trim
Selected heading
Synchro
Pickoff
RUDDER CHANNEL
Safety
Releasable bellcrank
Rudder
Torque motor control
Servo-control
Specific functions
Safety
Spoilers
Ailerons
Basic functions
Torque motor control
Preservo-control
Servo-control
Servo-control
Synchro
Pickoff
ROLL CHANNEL

FIGURE 9 – AUTOPILOT CONTROLS AND INDICATORS

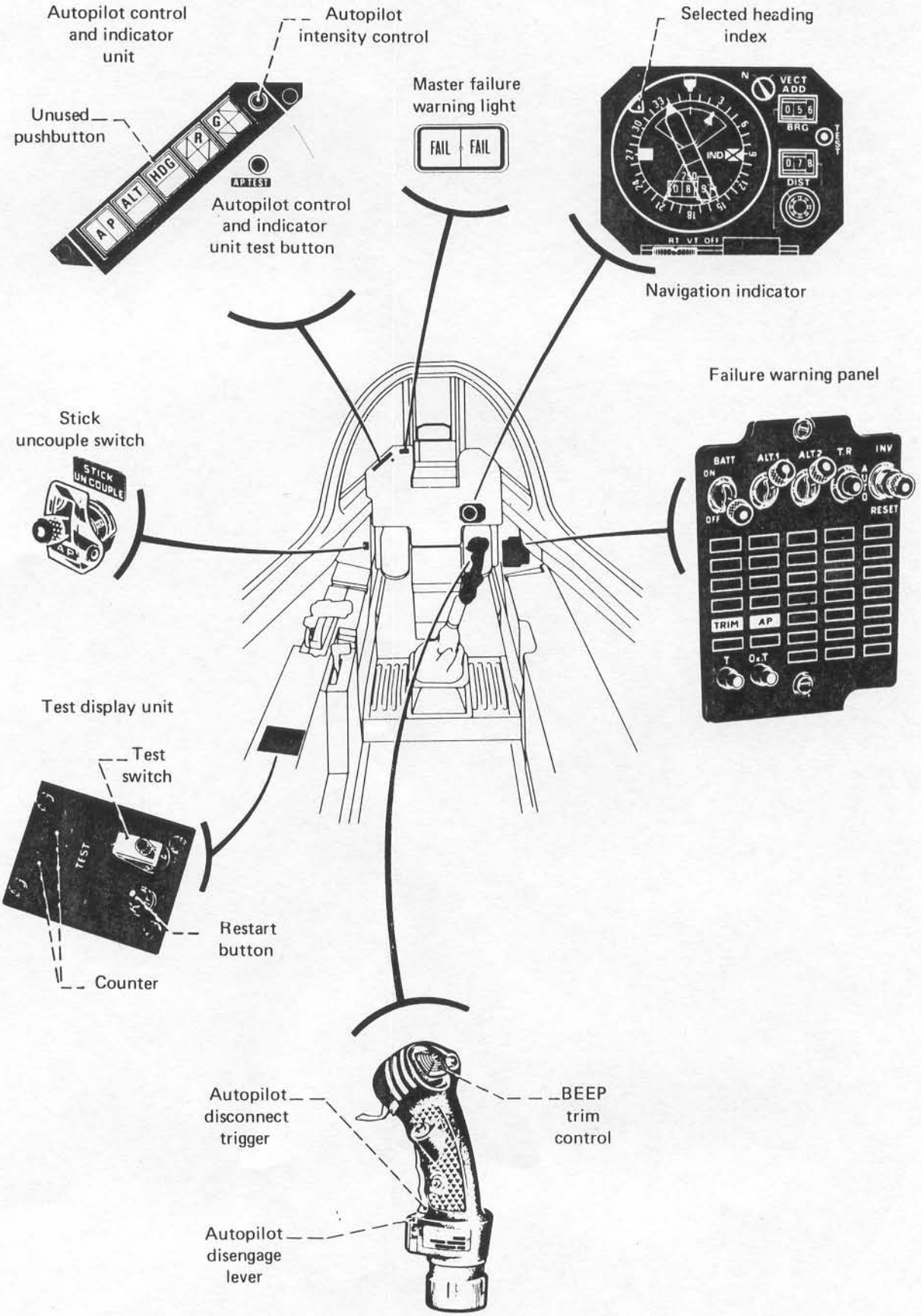


FIGURE 9 - AUTOPILOT CONTROLS AND INDICATORS

1,40 – HYDRAULIC ANCILLARIES AND BRAKE CHUTE

1,40 - HYDRAULIC ANCILLARIES AND BRAKE CHUTE

1,40.1 - HIGH-LIFT DEVICES, AIRBRAKES, SHOCK-CONES

1,40.1.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
HIGH-LIFT DEVICES	Slat/Flap lever	in 3 detents : half down all down	Locked at each extension detent
	Configuration indicator	Red - Amber - Green lights	
	High-lift device selector switch	3 positions : "NORMAL" "OFF" "EMG RETR"	 Auto slats and combat flaps if combat high-lift devices armed No auto slats or combat flaps Slat and flap emergency retraction
	Combat flap lever and combat flap button	2 positions : Lever out Lever in	The button allows the lever to come out Selection of combat flaps Retraction of combat flaps or combat flaps prohibited
	Master failure warning light	Amber	Testable by means of the "T" button on the failure warning panel
	"LIM" warning light	Red	Common to high-lift devices, U/C, Mach Testable
	S/F light	Amber	
	Combat flap light	Amber	"CBT F" steady on or flashing ; testable by means of the test button on the configuration indicator
	Circuit-breaker	"S/F"	
AIRBRAKES	Airbrake control switch	3 positions	
	Airbrake warning light	Amber	Testable
SHOCK-CONES			(See Engine)

(3) For both slats and flaps

- the slat/flap lever which is used for retraction and extension of the high-lift devices in "take-off/landing hight-lift devices" operating mode
- the high-lift device selector switch
- the combat flap lever and associated button : lever out = function armed
- the air data computer which feeds the servo units with the Mach number and IAS information required for the 1st interlock (the Mach number information is fed through the flying aid rack)
- the "LIM" warning light
- the configuration indicator
- the "CBT.F" and S/F lights
- the "S/F" circuit-breaker.

2 - AIRBRAKES

The aircraft is equipped with two fuselage airbrakes. Each airbrake is actuated by a jack.
A mechanical lock, which is unlocked hydraulically, maintains the airbrakes in the retracted position.

3 - SHOCK-CONES

The aircraft incorporates a system providing for maximum air intake efficiency as a function of the Mach number.
This system consists of a pair of shock-cones (mice) actuated by a hydraulic motor which is controlled automatically or manually in the event of automatic control failure.

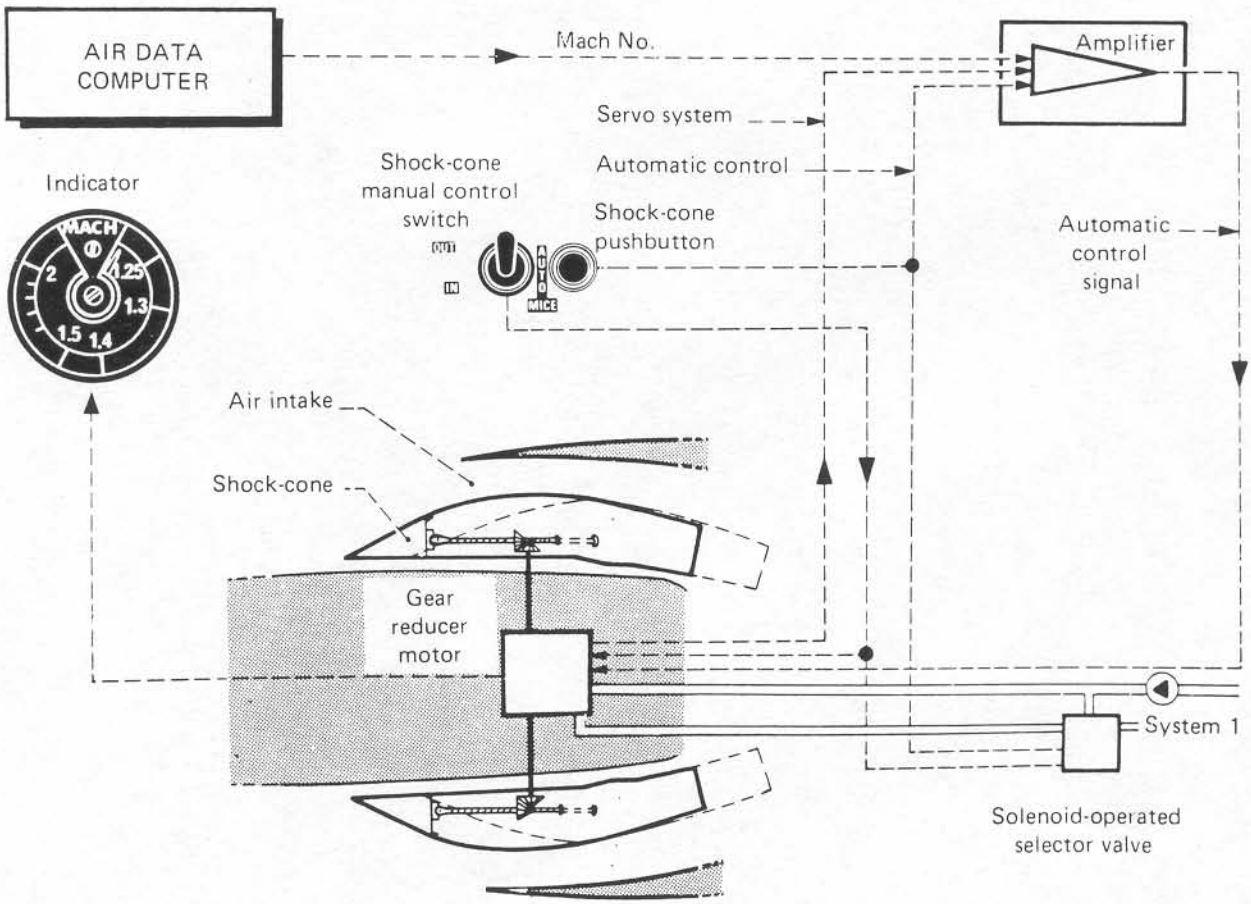


FIGURE 1 - SHOCK-CONE SYSTEM SCHEMATIC

As for the auto slats, a safety automatic retraction system acts if the 1st limit is reached with the combat flaps extended.

IAS ≥ 300 kt
or
M > 0.75
} Information provided by the flap capsule (1st interlock) and the air data computer, and processed in the high-lift device servo box.

If the 1st interlock is inoperative, a 2nd interlock, independent of the 1st one, operates as soon as :

IAS ≥ 335 kt
or
M > 0.85
} Information provided by the flap capsule (2nd interlock) for the speed and by the Mach number switch ; this information is processed in the high-lift device servo box.

Combat flap operation is normally controlled by the pilot inside the envelope limited by the 1st interlock ; the flaps can also be preselected out of the envelope and will extend only when inside the envelope (See SECTION 2, para. 2.25).

The other safety systems are of same design as those of the auto slats : thus, if the 2nd interlock operates, the «LIM» light illuminates throughout the flap retraction period, the [S/F] light illuminates and the «CBT F» light remains on. These two lights go out when the pilot retracts the combat flap lever.

The slotted slat comparator also operates in combat flap mode :

- its operation stops the outboard slat movement ; the [S/F] light comes on and the configuration indicator red light remains on.

For instance, if the comparator stops outboard slat operation, the high-lift device selector switch set to «EMG RETR» allows the slats to retract if the abnormality is not of mechanical origin.

If the high-lift device selector switch is turned «OFF», the slats and flaps remain retracted or retract whatever the position of the combat flap lever.

C - Control Through Slat/Flap Lever

This control must be used on takeoff and landing.

The slat/flap lever commands are fed to :

- the electric actuator to which the flap jacks are slaved
- the droop slat solenoid-operated selector valve
- the slotted slat gear reducer motors.

There are three positions :

- full up
- 1/2 flaps + full slats
- full flaps + full slats

The slat/flap lever overrides the combat high-lift device controls :

It is operative :

- if the high-lift device selector switch is set to «OFF» or to «NORMAL» whatever the combat flap lever positions, and whatever the flight conditions

It is inoperative :

- if the high-lift device selector switch is set to «EMG RETR» ([S/F] light on).

The slotted slat comparator is also effective in the takeoff/landing high-lift device configuration.

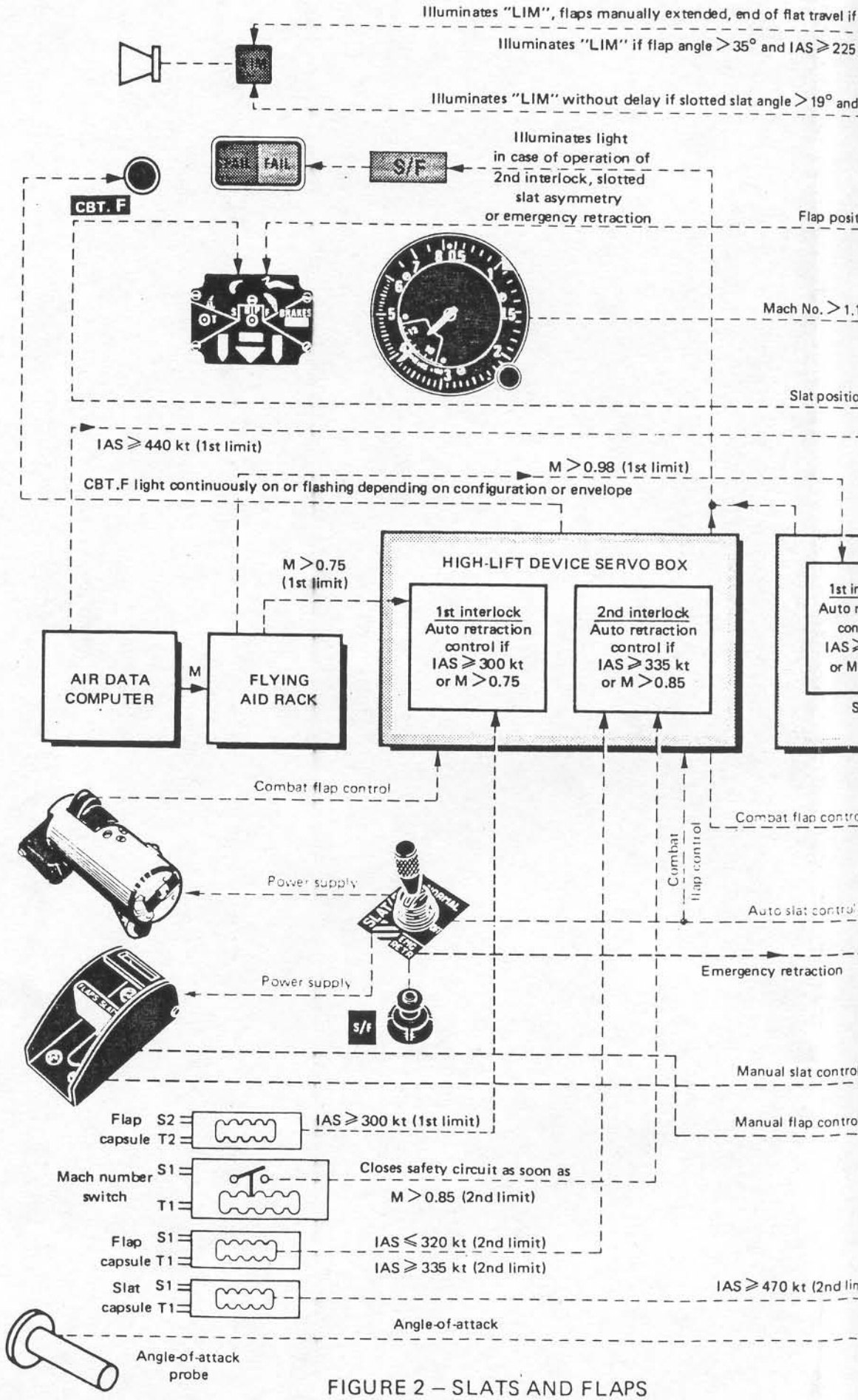
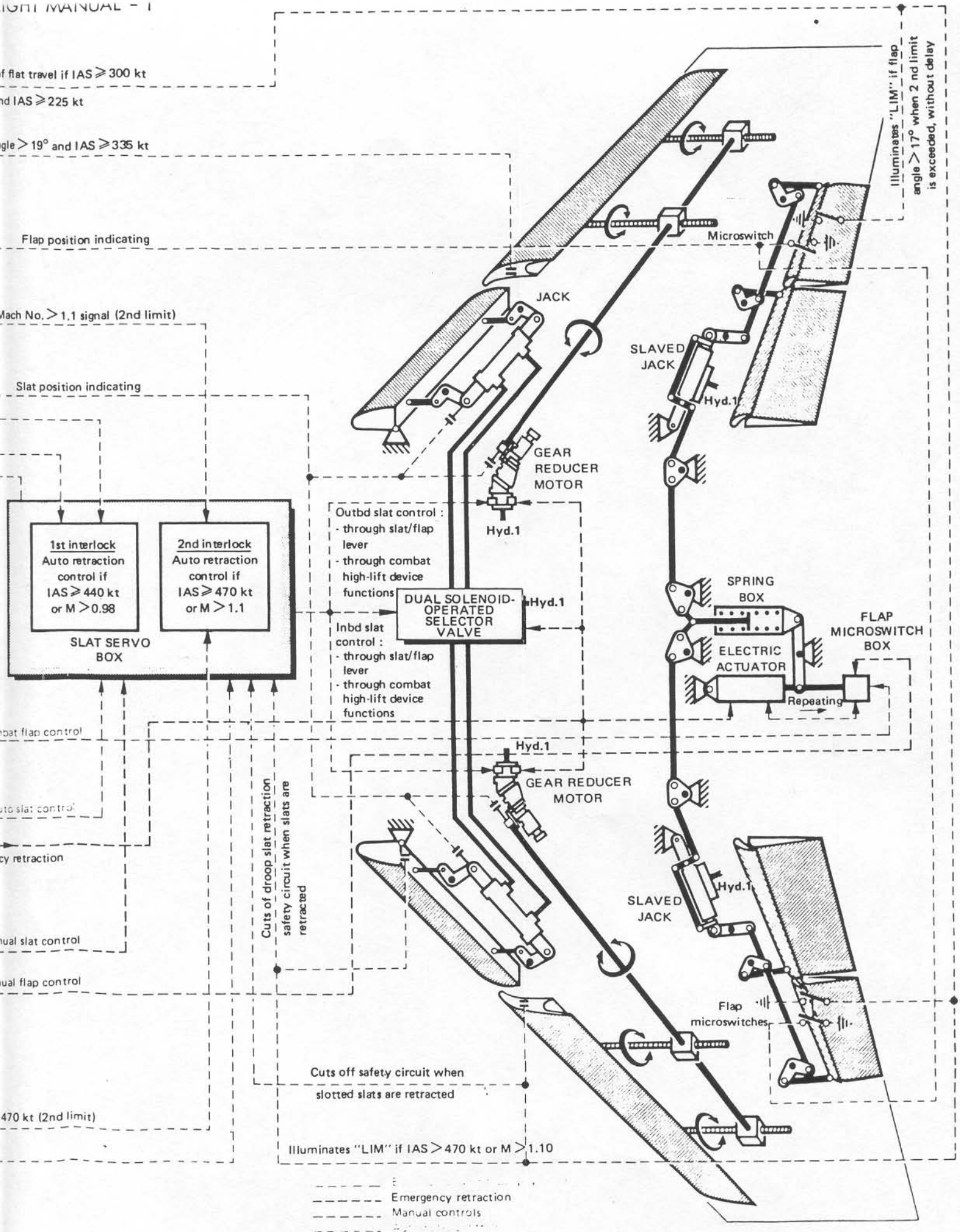

Illuminates "LIM", flaps manually extended, end of flat travel if
Illuminates "LIM" if flap angle > 35° and IAS ≥ 225
Illuminates "LIM" without delay if slotted slat angle > 19° and
LIM
FAIL
S/F
Illuminates light in case of operation of 2nd interlock, slotted slat asymmetry or emergency retraction
CBT. F
Flap posit
Mach No. > 1.
Slat positio
IAS ≥ 440 kt (1st limit)
M > 0.98 (1st limit)
CBT.F light continuously on or flashing depending on configuration or envelope
M > 0.75 (1st limit)
HIGH-LIFT DEVICE SERVO BOX
1st interlock Auto retraction control if IAS ≥ 300 kt or M > 0.75
2nd interlock Auto retraction control if IAS ≥ 335 kt or M > 0.85
AIR DATA COMPUTER
M
FLYING AID RACK
Combat flap control
Combat flap contro
Combat flap control
Power supply
Auto slat control
Emergency retraction
Power supply
S/F
Manual slat contro
Manual flap contro
Flap capsule S2 T2
IAS ≥ 300 kt (1st limit)
Mach number switch S1 T1
Closes safety circuit as soon as M > 0.85 (2nd limit)
Flap capsule S1 T1
IAS ≤ 320 kt (2nd limit)
IAS ≥ 335 kt (2nd limit)
Slat capsule S1 T1
IAS ≥ 470 kt (2nd lim
Angle-of-attack
Angle-of-attack probe

FIGURE 2 – SLATS AND FLAPS


f flat travel if IAS ⩾ 300 kt
nd IAS ⩾ 225 kt
gle > 19° and IAS ⩾ 335 kt
Flap position indicating
Mach No. > 1.1 signal (2nd limit)
Slat position indicating
1st interlock
Auto retraction control if IAS ⩾ 440 kt or M > 0.98
2nd interlock
Auto retraction control if IAS ⩾ 470 kt or M > 1.1
SLAT SERVO BOX
Outbd slat control :
- through slat/flap lever
- through combat high-lift device functions
Inbd slat control :
- through slat/flap lever
- through combat high-lift device functions
DUAL SOLENOID-OPERATED SELECTOR VALVE
Hyd.1
GEAR REDUCER MOTOR
JACK
SLAVED JACK
Microswitch
Illuminates "LIM" if flap angle > 17° when 2 nd limit is exceeded, without delay
SPRING BOX
ELECTRIC ACTUATOR
FLAP MICROSWITCH BOX
Repeating
bat flap control
uto slat control
cy retraction
Cuts of droop slat retraction safety circuit when slats are retracted
ual slat control
ual flap control
Flap microswitches
Cuts off safety circuit when slotted slats are retracted
470 kt (2nd limit)
Illuminates "LIM" if IAS > 470 kt or M > 1.10
Emergency retraction
Manual controls
Signals - Information - Indicating systems

D - INDICATING

The configuration indicator indicates :

(1) For the slats

lights out	:	full up
red light on	:	slats moving or stopped in an intermediate position
amber light on	:	slats extended in "auto slats" position
green light on	:	slats locked down in "take-off/landing" or "combat flaps" position

(2) For the flaps

lights out	:	flaps locked up
red light on	:	flaps moving or stopped in an intermediate position
amber light on	:	flaps in 1/2 flaps or "combat flaps" position
green light on	:	flaps in full flap position.

The S/F light on indicates :

- operation of the outboard slat position comparator (the configuration indicator slat red light is also on)
- operation of the 2nd interlock of the combat high-lift devices.
  In this case, the "LIM" light, together with the warning horn, illuminates during the slat and flap retraction period, and the "CBT F" light remains steady on as long as the combat flap lever is extended
- that the high-lift device selector switch has been left on "EMG RETR".

The "CBT F" light allows determination of the combat flap lever position relative to the operating envelope :

"CBT F" light out	:	combat flap lever retracted
"CBT F" light steady on	:	combat flap lever extended in the envelope
"CBT F" light flashing	:	combat flap lever extended out of the envelope or combat high-lift devices armed, flaps extended through the slat/flap lever.

The "LIM" light + warning horn :

- indicates that one of the two combat high-lift device safety limits has been reached with slats and flaps extended or not totally retracted

  470 kt or M = 1.10 for the auto slats

  335 kt or M = 0.85 for the combat flaps

- indicates that the maximum permissible speed is reached with the flaps in take-off/landing configuration

  300 kt for 1/2 flaps

  225 kt for full flaps.

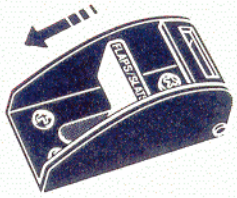
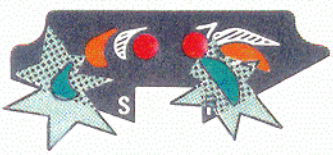
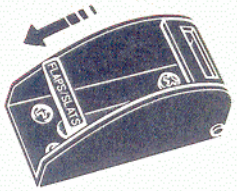
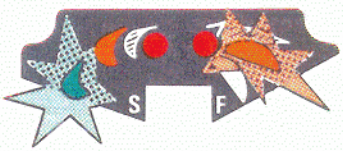
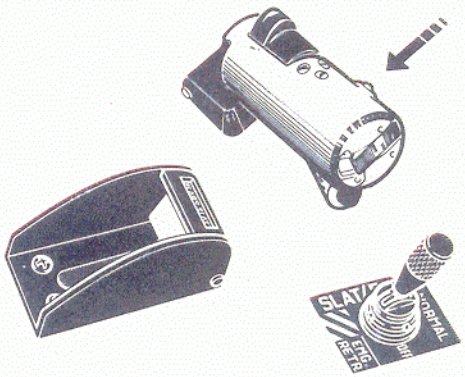
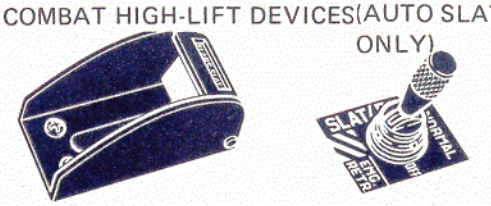
CONFIGURATION INDICATOR	TYPE OF CONTROL USED	"LIM" LIGHT
	TAKE-OFF/LANDING HIGH-LIFT DEVICES  1/2 down	On if IAS > 300 kt
	then	
	 Full down	On if IAS > 225 kt
	COMBAT HIGH-LIFT DEVICES (COMBAT SLATS AND FLAPS) 	
		IAS > 335 kt or M > 0 then out
	COMBAT HIGH-LIFT DEVICES(AUTO SLATS ONLY) 	On if IAS > 470 k or M > 1.10

FIGURE 2M - HIGH-LIFT DEVICE INDICATING

M" LIGHT	"CBT.F" LIGHT	S/F LIGHT	REMARKS
LIM	CBT. F	S/F	All lights out, slats and flaps retracted
LIM IAS > 300 kt	CBT. F	S/F	Red lights come on during operation Flap amber light on = Flaps 1/2 down Slat green light on = Slotted slats full down Droop slats down and locked
LIM IAS > 225 kt	CBT. F	S/F	Flap green light on = Flaps full down Red lights go out
LIM	CBT. F On, steady	S/F	Slat and flap extension is controlled within 1st limit envelope "CBT.F" on, steady Flap extension between 6 and 10 seconds
	CBT. F On, flashing	S/F	- Preselection of combat high-lift devices out of 1st limit envelope, pilot planning their use as soon as possible "CBT.F" flashes and then illuminates steadily within 1st limit envelope while flaps start extending or - Flaps are retracting through 1st limit or - Combat high-lift devices armed with flaps down through slat/flap lever
LIM 5 kt or M > 0.85 then	CBT. F On, steady	S/F	Operation of 2nd interlock
LIM out	CBT. F On, steady	S/F Stays on	Flaps retract
LIM IAS > 470 kt M > 1.10	CBT. F	S/F On if IAS > 470 kt or M > 1.10	Envelope exceeded ; as soon as slats are retracted : "LIM" goes out S/F will stay on

REMARKS : 1 - Full retraction of the flaps from the 1/2 flap position lasts six seconds ; meanwhile, certain combat phases can lead to a speed gain of 100 kt.

- below 17° deflection angle, the permissible envelope is larger ; one second approximately is necessary for the flaps to retract from 28° to 17°
- as soon as the flat backward movement completing the retraction is started, the flaps are considered as retracted.

A "LIM" light logic has therefore been associated with the combat flaps, which has the action of :

- illuminating the light as soon as the flaps reach the 2nd limit with a deflection angle higher than 17° (flap jamming or operation abnormally slow)
- neutralizing illumination of the light for three seconds during flap retraction from the moment the flaps reach the 17° deflection angle (which allows the flaps to complete their movement without illumination of the light).
  This logic also covers slat retraction.

2 - Take-off and approach are effected with the combat high-lift devices in prohibited position ; an omission from the pilot is covered by the "CBT F" light which flashes if the combat flap lever is extended in approach configuration (flaps extended through the slat/flap lever).

3 - Whatever the control used :

- the slats start extending upon control actuation
- the slats start retracting cnly when the flaps go through the 17° position.

Figure 2M sums up the indications provided in the three possible operating cases.

2 - AIRBRAKES

The airbrakes are controlled by means of a switch on the end of the throttle lever. Energy for actuation is supplied by hydraulic system 1 through the ancillary sub-system.
According to the way the switch is used, the airbrakes are operated :

- either in all-or-nothing mode, i.e. either fully in or fully out
- or by blips, which means that it is possible to apply airbrake action for periods as short as required.

When the switch is in the rest position (where it is held by a return spring), the airbrakes are in and locked, and the airbrake warning light is out.
When the switch is held pressed against the detent, the airbrakes extend. When the switch is released, it returns to the rest position and the airbrakes retract. This is the blip mode of operation.

When the switch is actuated beyond the detent, it locks in this position. The airbrakes extend and remain extended. To retract them, the head of the switch must be depressed. This is the all-or-nothing mode of operation.
It is not possible to maintain the airbrakes in an intermediate position.
The airbrake warning light illuminates when the airbrakes are not locked in.
In the extended position, the airbrakes are maintained extended by hydraulic pressure. In case of electrical or hydraulic supply failure, they retract under the action of the relative wind, irrespective of the switch position, but are not locked.

NOTE : Extension of the airbrakes at high speed causes a nose-down moment and rather strong vibrations.

3 - MICE (SHOCK-CONES)

The shock-cones are controlled in the automatic mode by commands from the air data computer. The automatic mode is initiated by depressing a button.
The repeated Mach number from the air data computer is compared to the signal from the servo potentiometer. The difference between both signals results in a differential current which is fed to a gear reducer motor including a servo valve, a hydraulic motor and a servo potentiometer. The energized servo valve then directs in the appropriate direction the hydraulic system 1 pressure (through a solenoid-operated selector valve) to the hydraulic motor. Through a gear reducer system, the hydraulic motor drives the shock-cones in the retraction or extension direction to a position in which the difference between the aircraft Mach number signal and the servo potentiometer signal is cancelled.
A three-position manual control switch (spring-loaded in neutral position) enables the automatic mode to be cancelled if anomalies occur, and to control the retraction or extension of the shock-cones manually.
When the shock-cones are retracted, the shock-cone position indicator reads 1.27.

1,40.1.4 - FAILURES

1 - PRESSURE DROP IN ANCILLARY SUB-SYSTEM OF HYDRAULIC SYSTEM 1

The slats, flaps, airbrakes and shock-cones are unserviceable if "ANC" = 0.

During an actuation sequence :
The slats lock in an intermediate position (red light on).
The flaps retract under aerodynamic effect, but do not lock.
The airbrakes retract under aerodynamic effect, but do not lock.
The shock-cones lock in the position existing at the time of failure.

2 - ELECTRICAL FAILURE

- The slats and flaps can no longer be controlled (combat or take-off/landing high-lift devices).
- If the failure occurs during actuation of the slats or flaps, the movement is interrupted and the high-lift devices remain in the position reached.
- The airbrakes retract (without locking) and can no longer be controlled.
- The shock-cones lock in the position existing at the time of failure (hydraulic motor servo valve supply).

3 - HIGH-LIFT DEVICE INTERLOCK OPERATION

(1) Asymmetry of slotted slats

The slats remain in the position existing at the time of interlock operation.
The S/F light comes on and the configuration indicator slat red light remains on.
The slat emergency retraction system can be used.

(2) Combat slat or flap envelope exceeded

The slats and flaps retract ; the "LIM" and S/F lights come on.
To re-use the high-lift devices, it is necessary :
- to retract then extend the combat flap lever if the flaps are concerned (the S/F light goes out)
- to turn "SLAT/FLAP" to "OFF" then "SLAT/FLAP" to "NORMAL" if the slats are concerned (the S/F light goes out).

4 - AIR DATA COMPUTER FAILURE : ADC light on

When an air data computer failure occurs, the 1st interlock should be considered as unserviceable ; only the 2nd interlock is operational. The safety level is not sufficient to normally use the combat high-lift devices.

5 - COMBAT SLAT OR FLAP EXTENSION FAILURE

This may be due to a failure of mechanical, hydraulic or electrical origin or to a malfunction of the interlocks.

(1) If the failure is of mechanical or hydraulic origin, it will not be possible to use the combat or take-off/landing high-lift devices.

(2) If the failure is of electrical origin, it may only affect the combat high-lift devices.

(3) In case of misadjustment of the interlocks, the failure can be identified and the action to be taken can be deduced by making attempts at lower speeds. The take-off/landing high-lift devices will still be operative.

(4) In case of flying aid gain "freezing" (fleeting failure, ADC light on), the Mach number interlocks will prevent operation of the combat flaps or combat slats and flaps, depending on the "frozen" Mach number values. The take-off/landing high-lift devices will still be operative.

6 - SLAT OR FLAP RETRACTION FAILURE

This may be due to a failure of mechanical, hydraulic or electrical origin.

(1) Failure of mechanical or hydraulic origin
Ancillary pressure = 0, combat flaps extended

- the droop slats remain locked in extended position

- the flaps may retract under aerodynamic effect.

(2) Failure of electrical origin

Emergency retraction should be attempted.

FIGURE 3 – HIGH-LIFT DEVICE, AIRBRAKE AND SHOCK-CONE CONTROLS AND INDICATORS

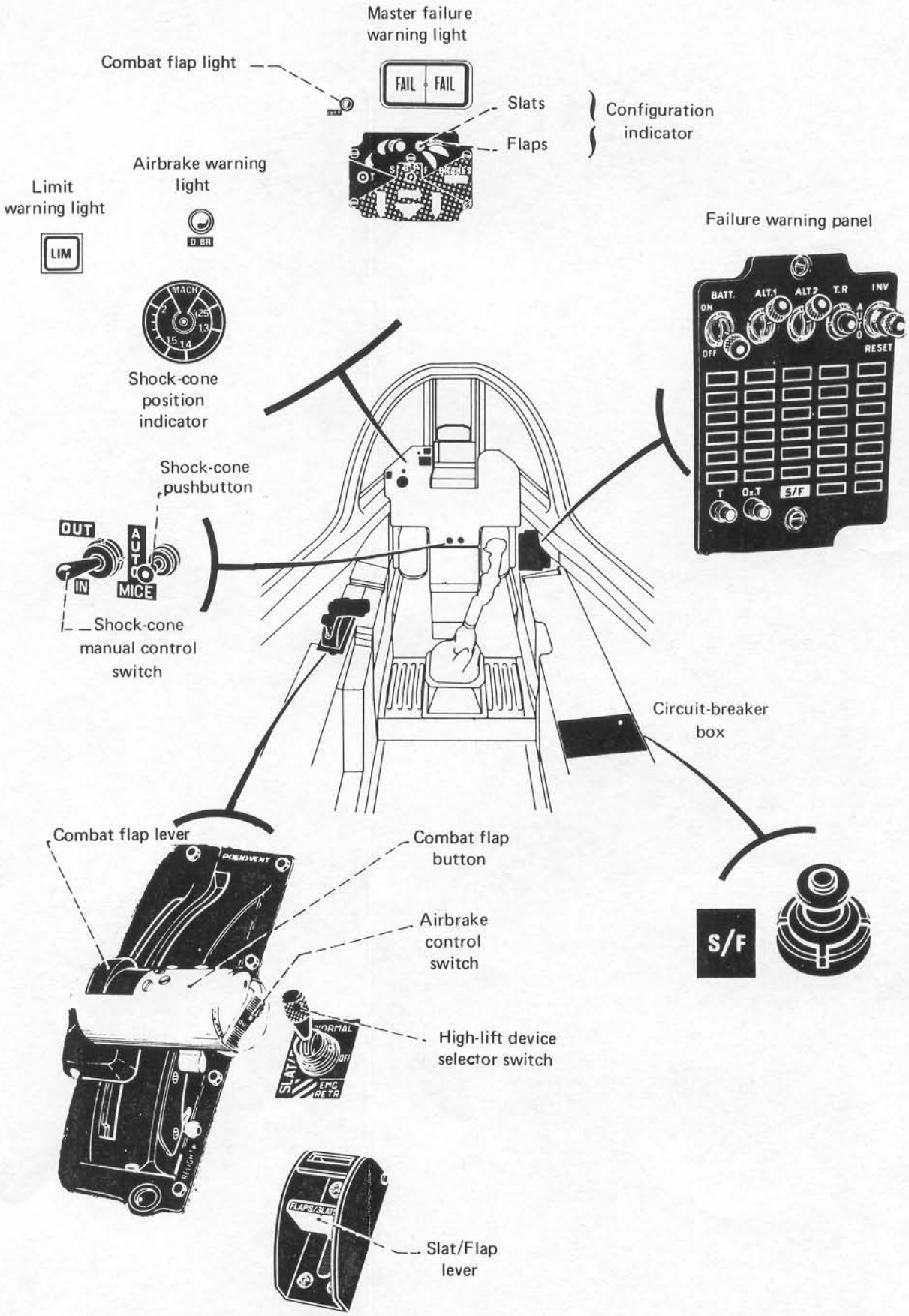


FIGURE 3 - HIGH-LIFT DEVICE, AIRBRAKE AND SHOCK-CONE CONTROLS AND INDICATORS

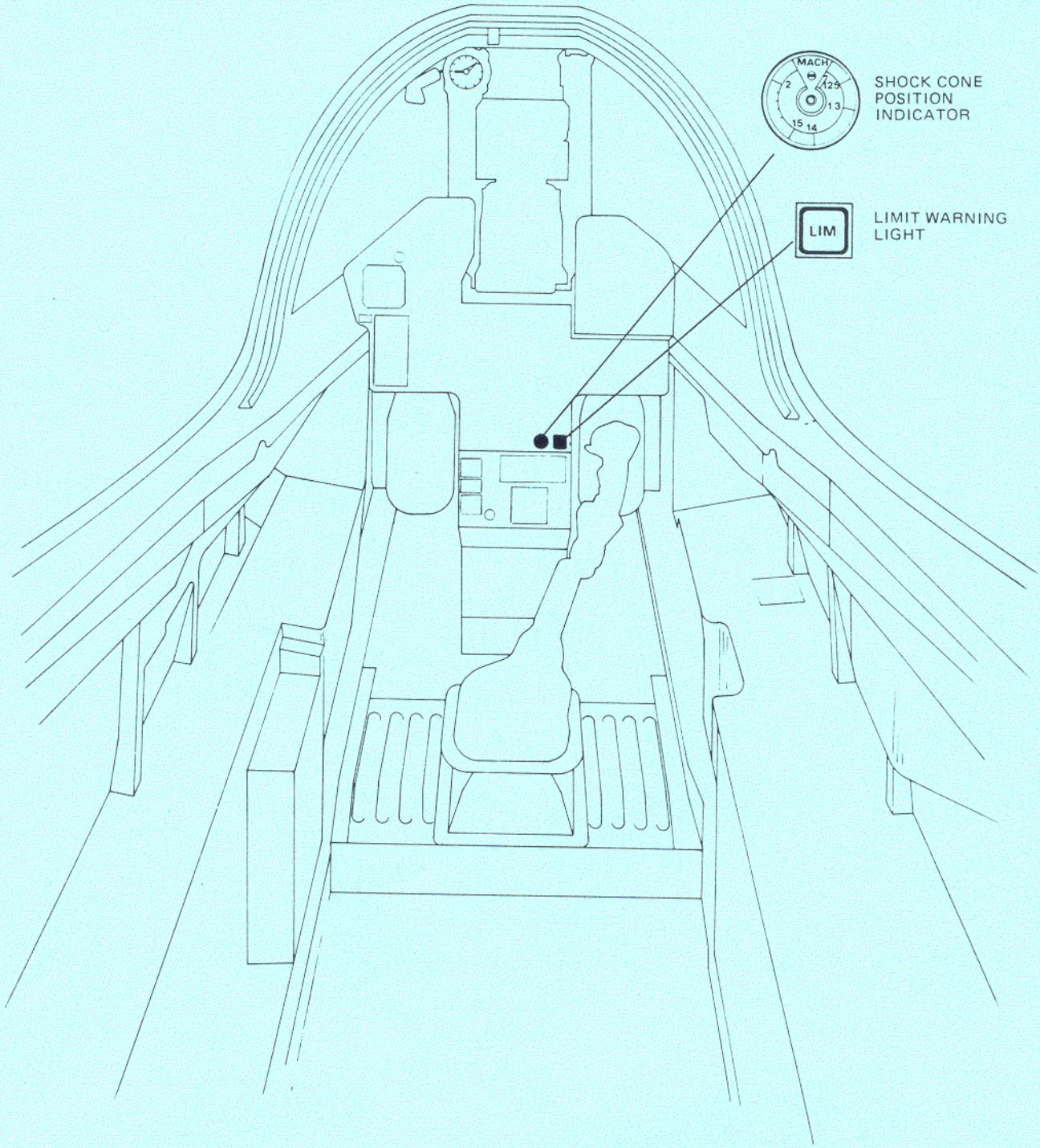


FIGURE 3A–HIGH-LIFT DEVICE, AIRBRAKE AND SHOCK-CONE CONTROLS AND INDICATORS (POST/SAAF/MOD/MIR/282)

1,40.2 - U/C, NOSE WHEEL STEERING SYSTEM, BRAKES, ANTI-SKID (SPAD) SYSTEM

1,40.2.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
U/C	U/C control lever	2 positions	With safety lever
	Emergency U/C handle		
	Configuration indicator	3 green arrows 1 red rectangle	Testable through indicator test button
	"U/C-not-down" warning light	"U/C" Red	Flashing { IAS < 215 kt and rpm < 8100 (96 %) } Testable
	Limit warning light	"LIM" Red	Illuminated when IAS ⩾ 240 kt
	"BIP" button	"BIP"	On configuration indicator
	Circuit-breaker	"U/C CONT"	Control safety
	Circuit-breaker	"U/C IND"	Indicator light safety
NOSE WHEEL STEERING SYSTEM	High sensitivity button		Button with magnetic locking
	Nose wheel steering light	Amber	On = nose wheel steering failure Testable through configuration indicator test button
	Rudder pedals		
	Nose wheel steering switch	Switch under striped guard	
BRAKES	Brake pedals		
	Emergency/Parking brake handle		Emergency : by turning Parking : by pressing button, pulling then turning
	Brake light	"BRAKES" Amber light on configuration indicator	Testable through configuration indicator test button
ANTI-SKID SYSTEM	Anti-skid (SPAD) switch	Guarded	
HYDRAULIC PRESSURE	Dual hydraulic pressure gauge		See Hydraulic System Section

1,40.2.2 - DESCRIPTION

1 - UNDERCARRIAGE

The aircraft is equipped with a tricycle fuselage undercarriage fitted with medium-pressure tyres.
The two main U/C legs are hinged to the fuselage on the sides of the engine compartment and retract forward into wells located on either side of the main frame. They are equipped with twin wheels.
The nose U/C leg is hinged to the fuselage aft of the cockpit and retracts backward into a well located between the air intakes. It is equipped with twin wheels.
The U/C wells are closed in flight by doors, most of which are also closed when the U/C is down.

2 - NOSE WHEEL STEERING SYSTEM

The nose wheel is equipped with a two-sensitivity, electro-hydraulic steering system. The connection between the controls (rudder pedals and nose wheel steering high sensitivity button) and the selector valve is electrical.
The twin wheel steering control jacks also provide for anti-shimmy.

3 - BRAKES

The aircraft is equipped with disk brakes which act on the four main wheels.
The braking system comprises :

- a normal system with an accumulator and two progressive selector valves. The progressive selector valves are directly controlled by the brake pedals and deliver to each pair of brakes (L/H and R/H) a pressure regulated through the anti-skid controller servo-valves.
- an emergency system with an accumulator and a progressive selector valve. The selector valve is directly actuated by a "Teleforce" flexible control linked to the emergency/parking brake handle. This braking system is not differential.

4 - ANTI-SKID (SPAD) SYSTEM

The purpose of the anti-skid system is to maintain at its best value the coefficient of adhesion of a tyre on the ground. Adhesion is dependent on tyre condition, nature of ground and, especially, wheel slipping. The latter, expressed in percentage, is the ratio between the rotational speed v of a braked wheel and the rotational speed V the free wheel would have. For a given type of ground surface, the adhesion of a tyre is maximum when slipping is about 17 % ; the anti-skid system permanently adjusts the braking pressure on each wheel to maintain this slipping value.
The data required for operation are as follows :

- the "ground" speed of the aircraft (detected by the freely rotating nose wheels)
- the actual speed of each braked wheel.

These data are transmitted to a controller unit which compares them and delivers to the wheel servo-valves the required pressure correction signals to maintain the 17 % slipping value.

The anti-skid system consists of the following :

Five speed detectors : these are five DC tachometer-generators mounted one on each one of the four braked wheels (main undercarriage) and one on the nose wheels. These generators feed the controller unit with a voltage proportional to the wheel rotational speed.

A controller unit : supplied with 115 V 400 cps power from the aircraft electrical system, this unit contains :

- four controllers associated with the four braked wheels ; each controller is fed with voltages representing the aircraft speed V (from the nose wheels) and the corresponding braked speed v. It compares v to the preset speed (corresponding to a slipping of 17 %) and determines the control current applied to the servo-valve winding and, consequently, the pressure delivered by the servo-valve.
- four burst tyre discriminators associated with the four controllers ; each discriminator disconnects the corresponding controller in case of bursting of the associated tyre.
- a "logic" board which stores a fictitious "aircraft speed" information corresponding to a speed of 140 kt.

The logic performs two functions :

- during the approach, it prevents braking as long as the wheels are not rotating.
- upon landing, when the aircraft is in a nose high attitude (nose wheels off ground), it feeds the controllers with the "aircraft speed" information which is not yet delivered by the nose wheels, thus allowing use of the brakes right upon touchdown on the main wheels.
  When the nose wheels are on the ground, Vo is no longer provided due to the action of the compressed nose U/C shock-absorber microswitch and the nose wheels which start rotating ; the nose wheels then provide the "ground speed" V information.
- two servo valves : there is one servo valve for each twin wheel, supplied by the corresponding progressive selector valve.

1,40.2.3 - OPERATION

1 - UNDERCARRIAGE

A - Normal operation

Energy is supplied by the ancillary sub-system of hydraulic system 1.
Action on the U/C control lever causes electrical power to be supplied by the main DC system to the solenoids of the selector valves. Contactors ensure the following sequences of operation :

- on retraction :
  . after extension of the shock-absorbers, the doors open and lock
  . the three U/C legs retract and are locked up
  . the doors close and lock.
- on extension :
  . the doors open and lock
  . the three U/C legs extend and are locked down
  . the doors close and lock.

Each sequence is authorized by the normal execution of the preceding one.

CAUTION

WHEN THE U/C IS OPERATED, WAIT UNTIL IT IS FULLY STOPPED BEFORE INITIATING THE REVERSE OPERATION.

B - Indicating

- a hydraulic pressure gauge indicates the pressures available
- a flashing red "U/C" warning light comes on when any of the U/C legs is not extended or locked down when the engine rpm is below 8100 or 96 % (throttle lever microswitch) and the IAS is less than 215 kt
- a steady red "LIM" warning light comes on when the nose U/C leg is not locked up or when the forward door is not locked closed when the IAS is higher than 240 kt
- a "U/C/Slat/Flap" configuration indicator indicates on its U/C section :
  . three green lights : the corresponding U/C leg is locked down
  . one red light : all the doors are not locked closed.
- an audio signal is generated when the U/C is locked down and the pilot depresses the "BIP" button. This signal is transmitted on the selected communications frequency and heard by the pilot.

C - Safety systems

- two circuit-breakers protect the control system and the indicator lights
- a safety lever with stable positions locks the U/C control lever in its two positions (up and down)
- an anti-retraction system prohibits movement of the control lever as long as the L/H U/C shock-absorber or the nose U/C shock-absorber is not extended
- a lockwired override button, located above the control lever, allows the anti-retraction system to be mechanically unlocked in case of absolute necessity (crash for example)
- the doors can be opened on the ground by means of unlocking levers installed in the U/C wells. A safety device prevents accidental closing of the doors.

D - Emergency operation

Emergency U/C operation is possible in the extension direction only.
The various jacks are supplied by the ancillary sub-system of hydraulic system 2 by an entirely independent system.

Actuating the emergency U/C handle mechanically operates a three-position selector valve :

1 - Handle folded (rest position) : normal system in operation
2 - Handle partially pulled out (after a 30° rotation) :
  - system 1 is isolated by the controlled selector valve
  - the outboard discharge valves in system 1 return are opened
  - the electrical power supply to the normal extension system solenoids is cut off
  - the door opening jacks are supplied by hydraulic system 2
3 - Handle completely pulled out (after an additional 60° rotation) :
  - the U/C extension jacks are supplied by hydraulic system 2
4 - The handle is locked by a 30° rotation (in the clockwise direction)

The double action of the handle corresponds to a sequence which avoids all interference between the U/C legs and the doors during extension.

After emergency U/C extension, the doors remain locked open (red light illuminated).
The BIP system is operative.

Emergency U/C extension followed by normal U/C retraction results in the loss of a certain amount of fluid from system 2 for the following reasons :

- Emergency U/C extension :
  Part of system 1 fluid is lost in the chamber opposite to the jacks. This fluid is discharged overboard through two outboard discharge valves.
- Normal U/C retraction :
  Causes a volume of fluid supplied by system 2 and equivalent to that of the jack chamber to be returned to the system 1 reservoir.

As a result, there is a loss of fluid from system 2. Reservoir replenishment is necessary.

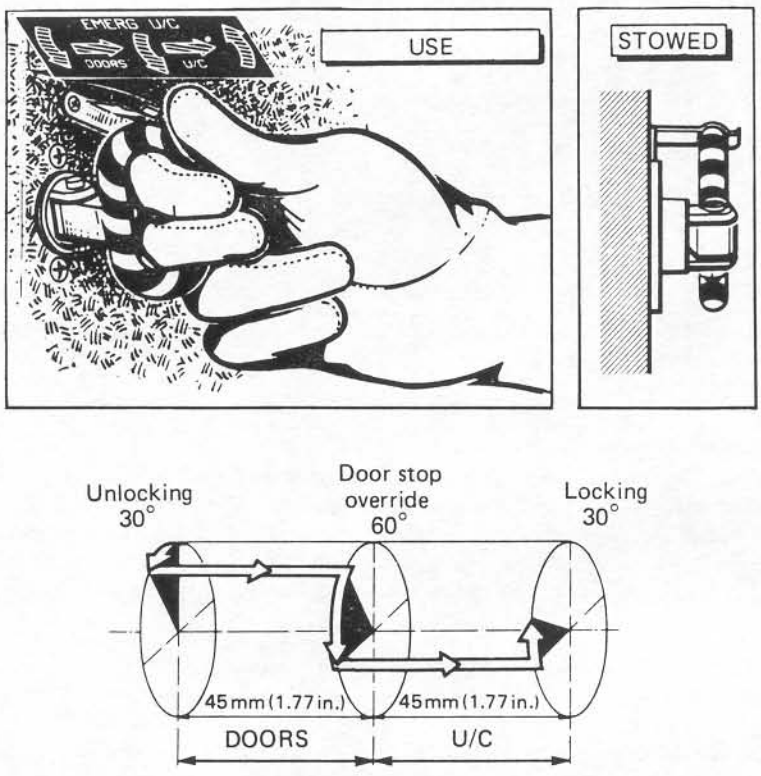


FIGURE 4 - EMERGENCY U/C HANDLE OPERATION

2 - NOSE WHEEL STEERING SYSTEM

The hydraulic supply is provided by system 2.
A calibrated valve enables a sufficient pressure to be maintained to ensure the antishimmy function in case of loss of the system 2 pressure.
The pilot may select high sensitivity by depressing the button when the aircraft is on the ground with the nose shock strut compressed.
The "NOSE" light, when illuminated, indicates that the nose wheel steering system is unserviceable.
Steering is controlled by the rudder pedals ; the rotational angle of the twin wheels is ± 7° in low sensitivity and ± 45° in high sensitivity, which is obtained at 70 % travel of the rudder pedals.
A nonlinear system reduces the sensitivity of the system in the neutral position.
On takeoff, as soon as the nose twin wheels have left the ground, the shock strut microswitch shuts off the hydraulic power supply and the button pops out if it was depressed.
A pressure accumulator in the nose wheel steering system permanently supplies the antishimmy device.
In case of malfunction, the hydraulic supply to the system can be shut off by means of the nose wheel steering switch.
It the failure is due to the power supply, the antishimmy function is still available.

3 - BRAKES :

Normal :
- The action on the pedals transmits a pressure, regulated through a servovalve controlled by a regulation box, to each pair of brakes. If a defect occurs, the regulation can be cut out and direct braking reestablished by means of the antiskid switch.

During U/C retraction, hydraulic pressure 1, derived from the retraction selector valve, actuates the emergency brake selector valve which automatically brakes the main wheels.
When the "ANC" pressure = 0, the normal accumulator still permits about five applications of the brake pedals without antiskid system.

NOTE : With the antiskid (SPAD) system in operation, the number of applications is reduced due to the higher hydraulic energy consumption.

Emergency :
- Braking is obtained by rotating the emergency/parking brake handle counterclockwise.

NOTE :
- This action must be progressive to prevent wheel locking.
- The antiskid system is inoperative as the emergency system does not run through the servovalves.

Parking :
The parking brake is operated by :
- unlocking the emergency/parking brake handle by depressing its central button,
- pulling out the handle (40 mm),
- turning it counterclockwise.

NOTE : Do not depress brake pedals while operating the handle.

It is released by :
- depressing the central button and pushing the handle fully home.

The "BRAKES" light on the configuration indicator comes on when the pressure is higher than 14 bar (333 psi) and goes out when the pressure is lower than 13 bar (188 psi).

To check the brakes for proper operation before landing, the following tests must be performed :

1) - U/C up : successively depress then release each pedal :
- the "BRAKES" light should come on when each pedal is depressed and then go out when it is released; the brake system can normally be used with the antiskid system
- if the "BRAKES" light does not come on when each pedal is depressed, this denotes an electrical malfunction (antiskid system not cut off or wheel microswitch unserviceable) or a hydraulic malfunction (defective servovalve operation) in the brake system. In this case, the emergency brake system will have to be used (See para. 4,40.2, SECTION 4)

2) - U/C down : depress both pedals at the same time :
- the "BRAKES" light should remain out ; this denotes normal operation of the brake system ; the antiskid system will operate
- if the light comes on, the system is defective ; the malfunction may be electrical (antiskid system) or mechanical (servovalve).
  In this case, the brakes will have to be used with caution (See para. 4,40.2, SECTION 4).

4 - ANTI-SKID SYSTEM

The operation of the anti-skid (SPAD) system is summarized in the following table.

FLIGHT PHASE	WHEEL POSITION	INFORMATION RECEIVED BY CONTROLLER	INFORMATION GENERATED BY CONTROLLER	CONSEQUENCE	SLIPPING	SYSTEM ACTION
Approach	Main wheels motionless Nose wheels motionless	–	–	Braking impossible	–	
Landing Contact on main wheels Nose wheels off ground	Main wheels rotating Nose wheels motionless	v Memory Vo = 140 kt	Vo/v	Braking possible but cautiously	17 % < 17 % > 17 %	Constant braking Braking action increase Braking action decrease
Ground roll	Main wheels rotating Nose wheels rotating	v V	V/v	Braking possible. See braking technique in para.2.25.9	17 % < 17 % > 17 %	Normal braking Braking action increase Braking action decrease

NOTE : A switch is provided to disconnect the anti-skid system in the event of malfunctioning ; conventional braking is then available.

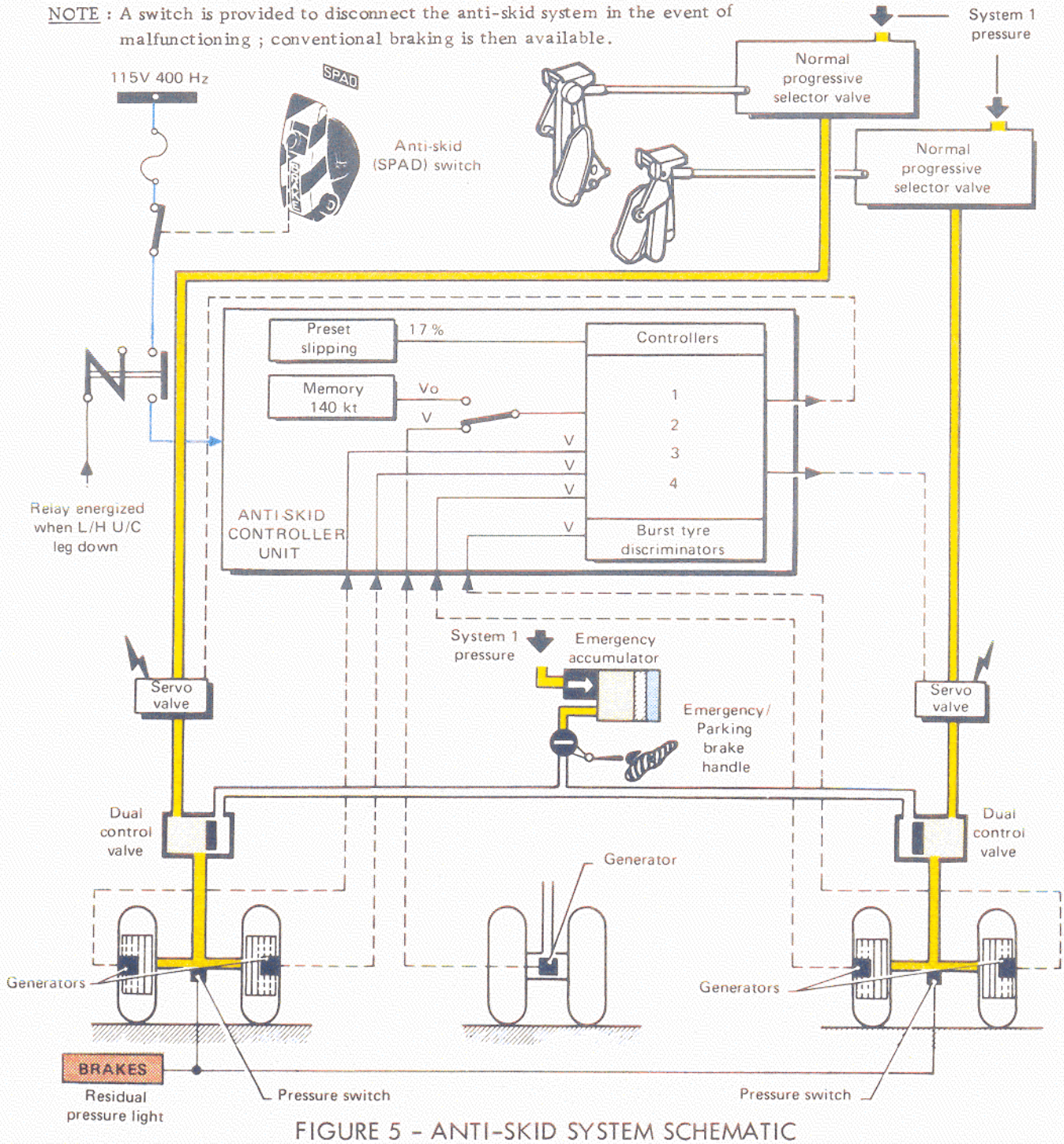


FIGURE 5 - ANTI-SKID SYSTEM SCHEMATIC

1, 40. 2. 4 - FAILURES

1 - UNDERCARRIAGE

- The loss of hydraulic system 1 or of its ancillary sub-system, or of the electrical sequences makes normal U/C retraction or extension impossible. Emergency U/C extension remains possible.
- The loss of hydraulic system 2 allows normal U/C retraction and extension, but makes emergency U/C extension impossible.

REMARK : Under exceptional conditions, it is possible to retract the undercarriage on the ground by depressing the anti-retraction override button located above the control lever. The mechanical action of this button overrides the magnetic lock of the control lever which can then be placed in the up position.

Comments on the use of the emergency U/C extension system

FAILURE	ACTION		REMARKS	LOSS OF HYDRAULIC SYSTEM 2 FLUID
"ANC" = 0 or HYD.1 light on	Control lever in down position	Emergency U/C extension	Retraction impossible	Maximum = 1.8 litres (0.4 Imp. gal - 0.5 U.S. gal)
No sequence	Control lever in down or up position	Emergency U/C extension	(1) U/C extension obtained : the failure was electrical ; leave the U/C down	Maximum = 1.8 litres (0.4 Imp. gal - 0.5 U.S. gal)
			(2) Still no sequence : the failure is mechanical ; try repeatedly to obtain normal or emergency U/C extension	Zero
Sequence interrupted	Leave control lever in down position	Use emergency U/C extension	(1) Locking obtained : the failure was electrical ; leave U/C down (2) No result : the failure is mechanical ; push emergency U/C handle back in, retract U/C by raising U/C control lever. Try repeatedly for normal U/C extension with control lever only. Use of the emergency U/C handle will not remedy and cause loss of hydraulic fluid each time it is used	Depends on U/C position at the moment of emergency operation. As this is not known, emergency handle should not be actuated more than twice

To summarize : When the use of the emergency U/C handle confirms a failure of the normal U/C extension system, it is useless to repeat operation of the emergency U/C handle and this can even be dangerous by risking the loss of hydraulic system 2.
In all cases, emergency U/C extension should be performed with the U/C control lever in the down position so as to minimize hydraulic fluid losses.

2 - NOSE WHEEL STEERING SYSTEM

- Illumination of the light indicates a nose wheel steering system failure in the following cases :
  - on the ground, when the hydraulic pressure is lower than 72 bar (1044 psi)
  - in flight, when the hydraulic pressure is higher than 85 bar (1232 psi) or when an electrical failure has occurred.

3 - BRAKES :

- If anomalies are noticed during braking, the anti-skid system can be isolated by operating the anti-skid (SPAD) switch, which will show whether the trouble is due to this system. The brakes must then be used with caution, since the pressures delivered by the selector valve are no longer regulated.
- If a residual pressure is indicated by the configuration indicator light, there is a risk of overheating the brakes ; taxiing should be limited to the necessary minimum.
- In case of "ANC" pressure loss, the brakes remain usable in the normal mode (brake pedals), with or without the anti-skid system, and in the emergency mode (emergency/parking brake handle) through the accumulators of the two braking systems ; use of the brakes is limited to the capacity of the accumulators.

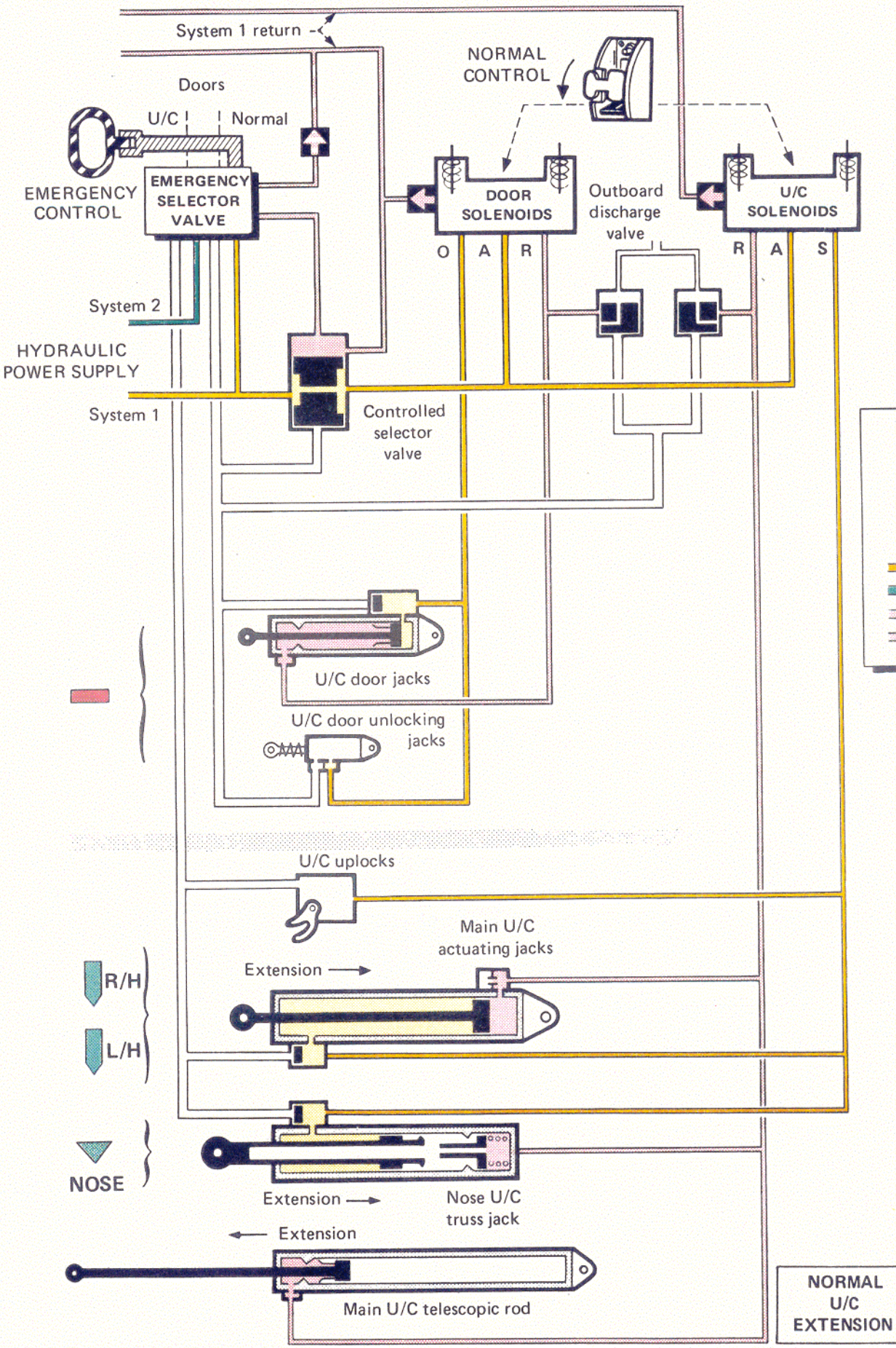
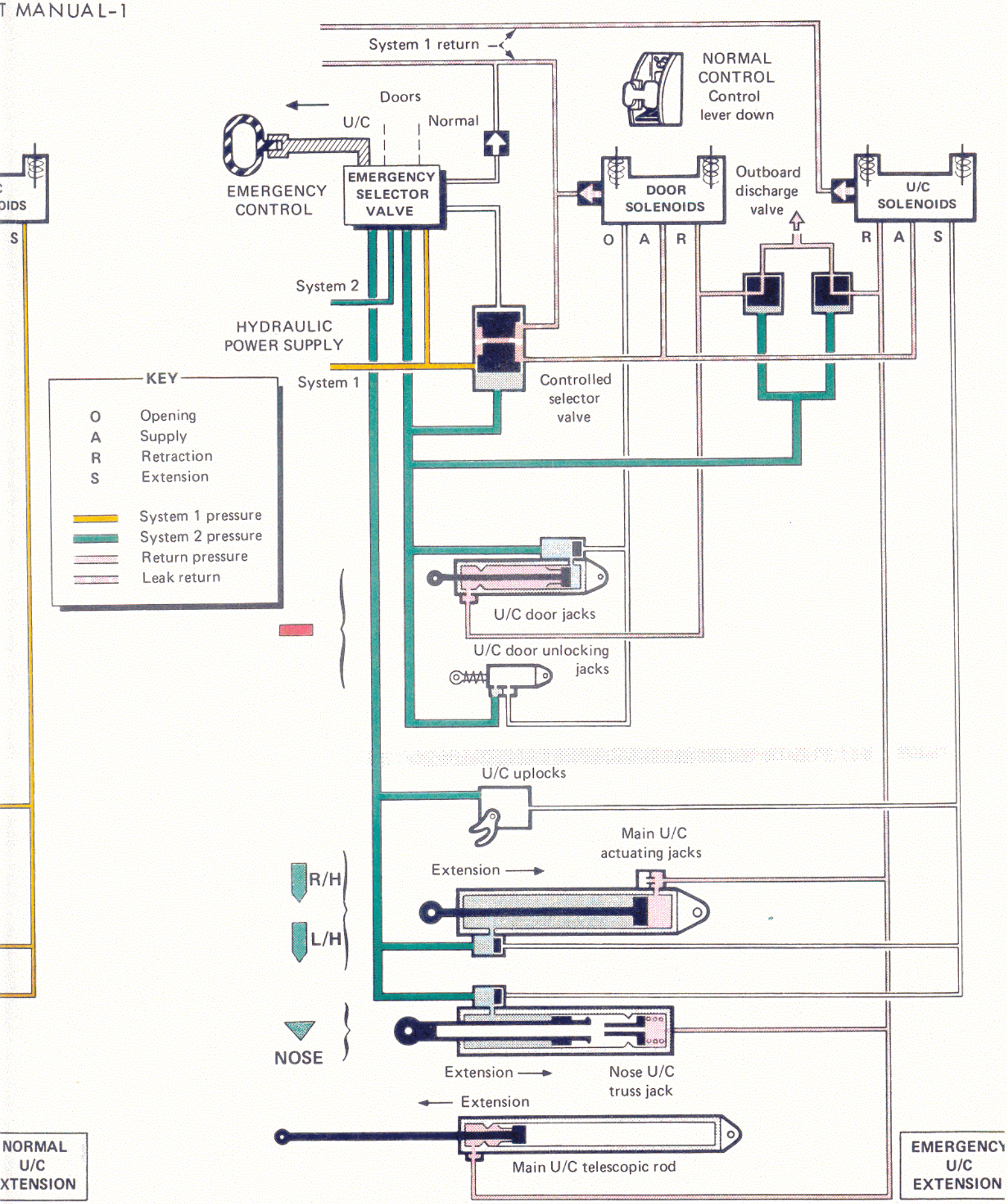
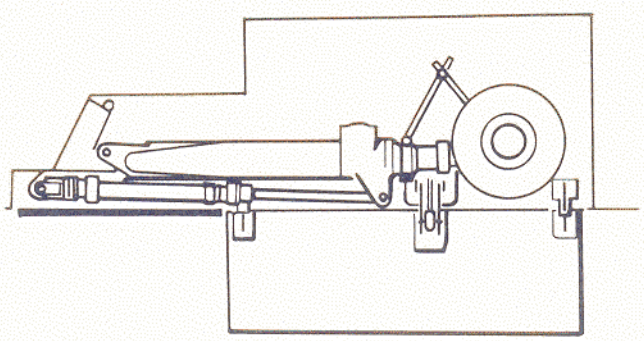
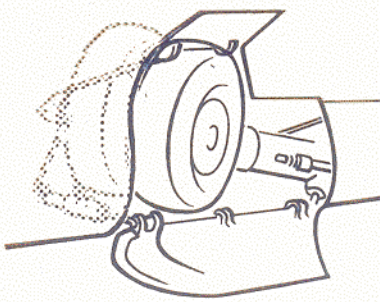


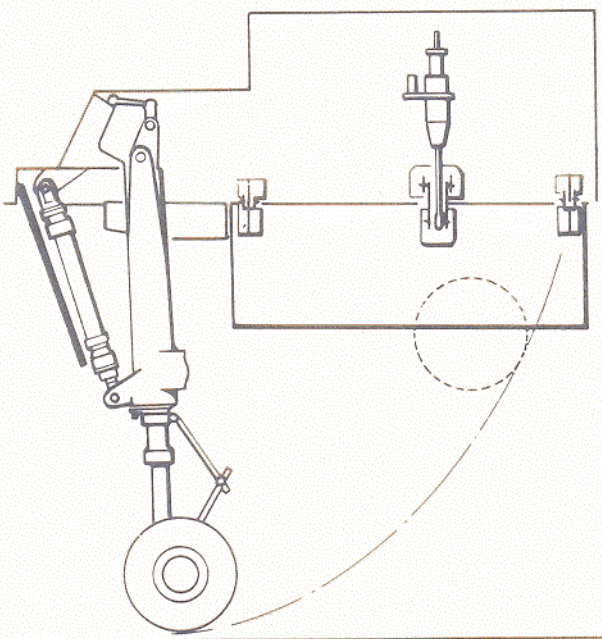
FIGURE 6 - U/C AND U/C DOOR HYDRAULIC SHEMATIC DIAGRAM

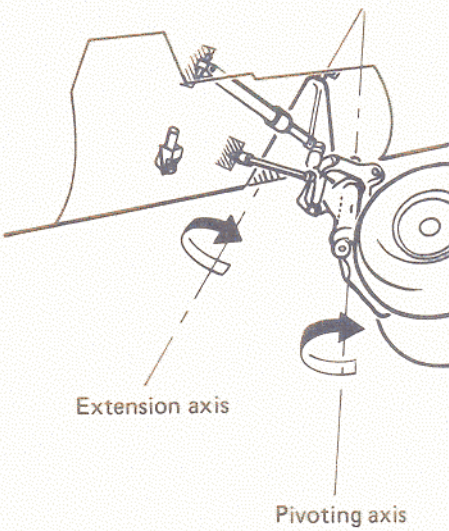

System 1 return
NORMAL CONTROL
Control lever down
Doors
U/C
Normal
EMERGENCY CONTROL
EMERGENCY SELECTOR VALVE
DOOR SOLENOIDS
O A R
Outboard discharge valve
U/C SOLENOIDS
R A S
System 2
HYDRAULIC POWER SUPPLY
System 1
Controlled selector valve
KEY
O Opening
A Supply
R Retraction
S Extension
System 1 pressure
System 2 pressure
Return pressure
Leak return
U/C door jacks
U/C door unlocking jacks
U/C uplocks
Main U/C actuating jacks
Extension
R/H
L/H
NOSE
Extension
Nose U/C truss jack
Extension
Main U/C telescopic rod
NORMAL U/C XTENSION
EMERGENCY U/C EXTENSION

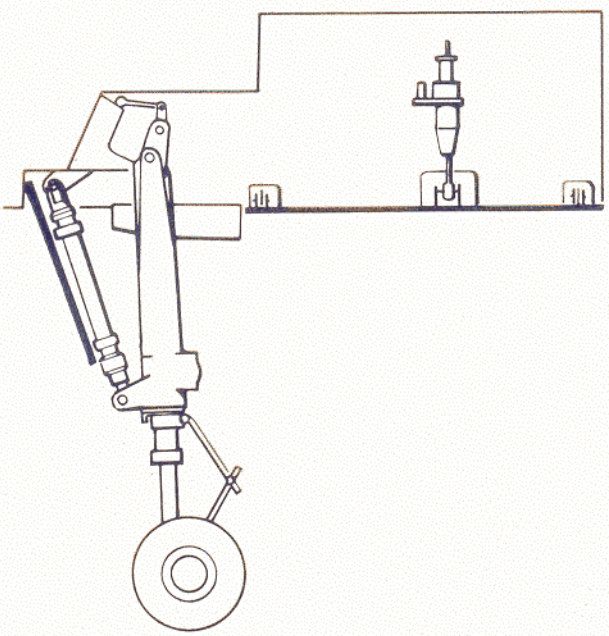
U/C UP	IAS < 215 kt and throttle retarded to RPM < 8100











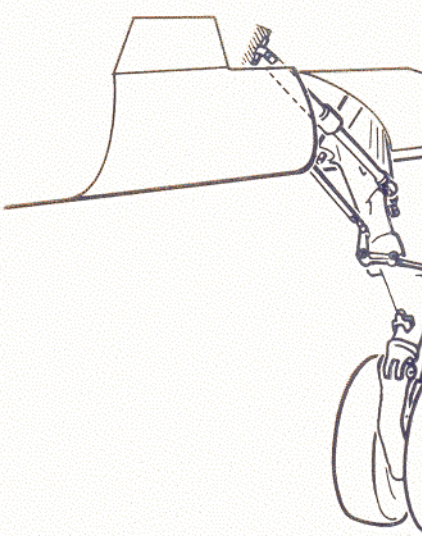
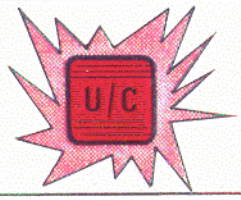
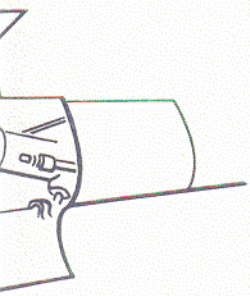


FIGURE 7 - NORMAL U/C EXTENSION

PM < 8100 or 96 %



1st PHASE

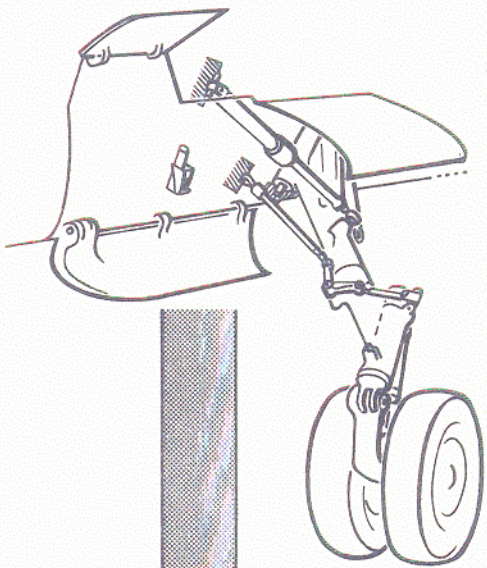


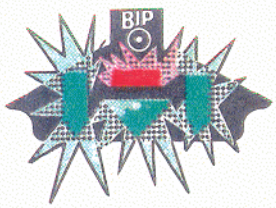
Illuminated when IAS ⩾ 240 kt

U/C DOOR OPENING AND LOCKING

2nd PHASE

ting axis

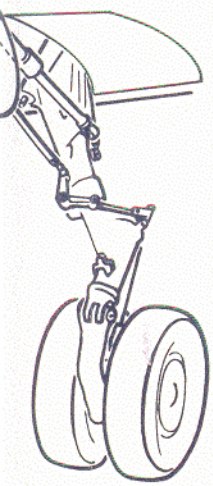


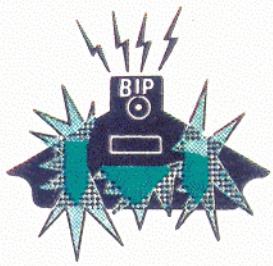


Illuminated when IAS ⩾ 240 kt

U/C EXTENSION AND LOCKING

3rd PHASE





Illuminated when IAS ⩾ 240 kt

U/C DOOR CLOSING

FIGURE 8 – BRAKE SYSTEM

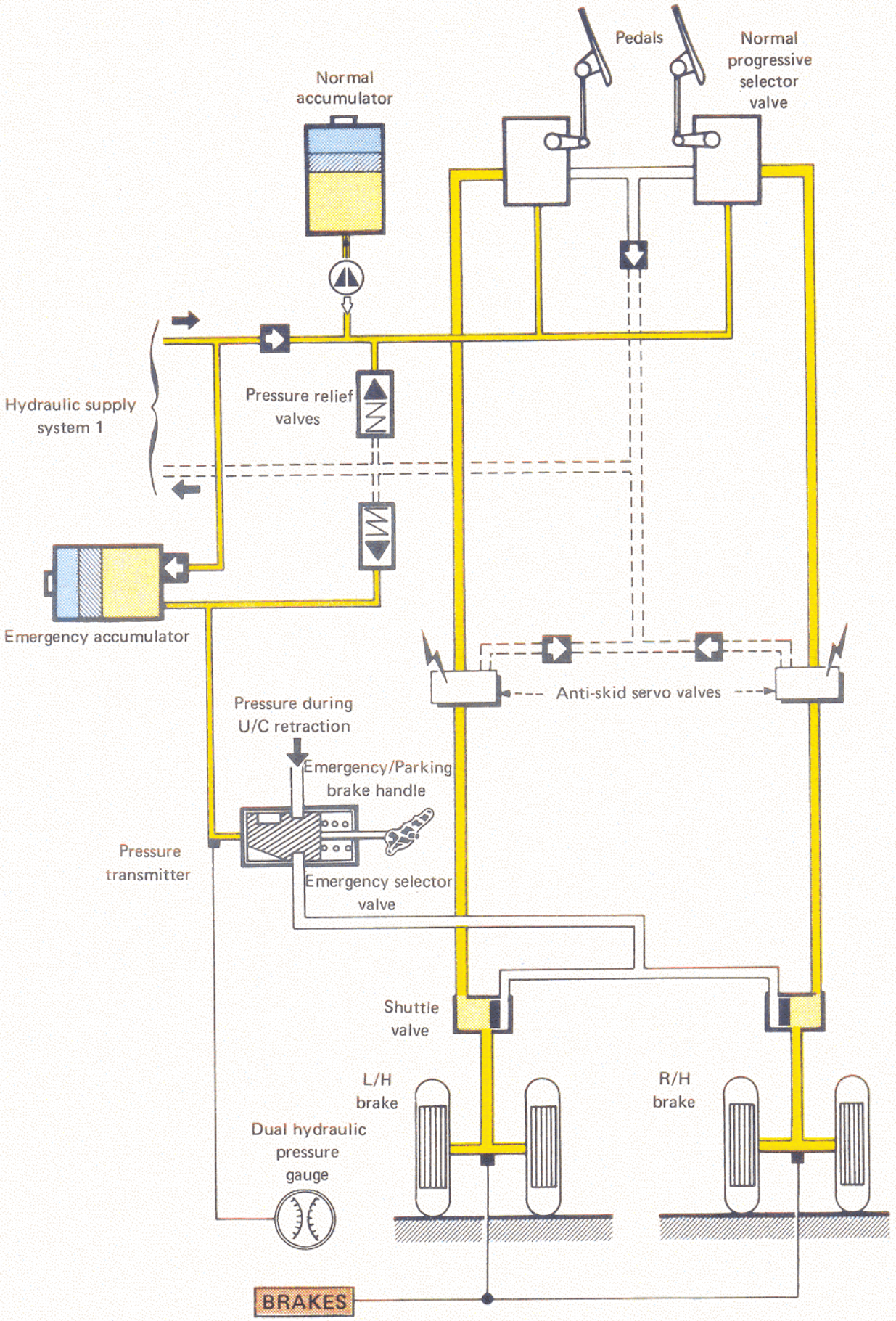


FIGURE 8 - BRAKE SYSTEM

1,40.3 - BRAKE CHUTE

1,40.3.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
Brake chute	Brake chute control	Lever	Folding lever tip

1,40.3.2 - DESCRIPTION

The brake chute is of the cruciform type ; it is housed inside a container closed by a cap. The assembly is located at the bottom of the fin, under the rudder : it can be deployed up to 210 kt without any risk of failure of the straps or tearing of the canopy.

1,40.3.3 - OPERATION

The brake chute is mechanically controlled through the movement of the control lever. Moving the lever aft opens the chute ; returning the lever forward drops the chute.
The retaining hook is normally closed but not locked, so that the chute can be released in case of accidental opening.
When the lever is moved aft, the hook jaws lock and the cap is ejected by a spring and extracts the chute.
When the lever is moved forward, the jaws open and the chute is released.

1,40.3.4 - FAILURES

Jamming in the container or accidental release due to a broken strap : no deceleration.
Defective opening due to broken or tangled shroud lines : low, but not negligible deceleration.

FIGURE 9 – U/C, NOSE WHEEL STEERING, BRAKE, ANTI-SKID AND BRAKE CHUTE CONTROLS AND INDICATORS

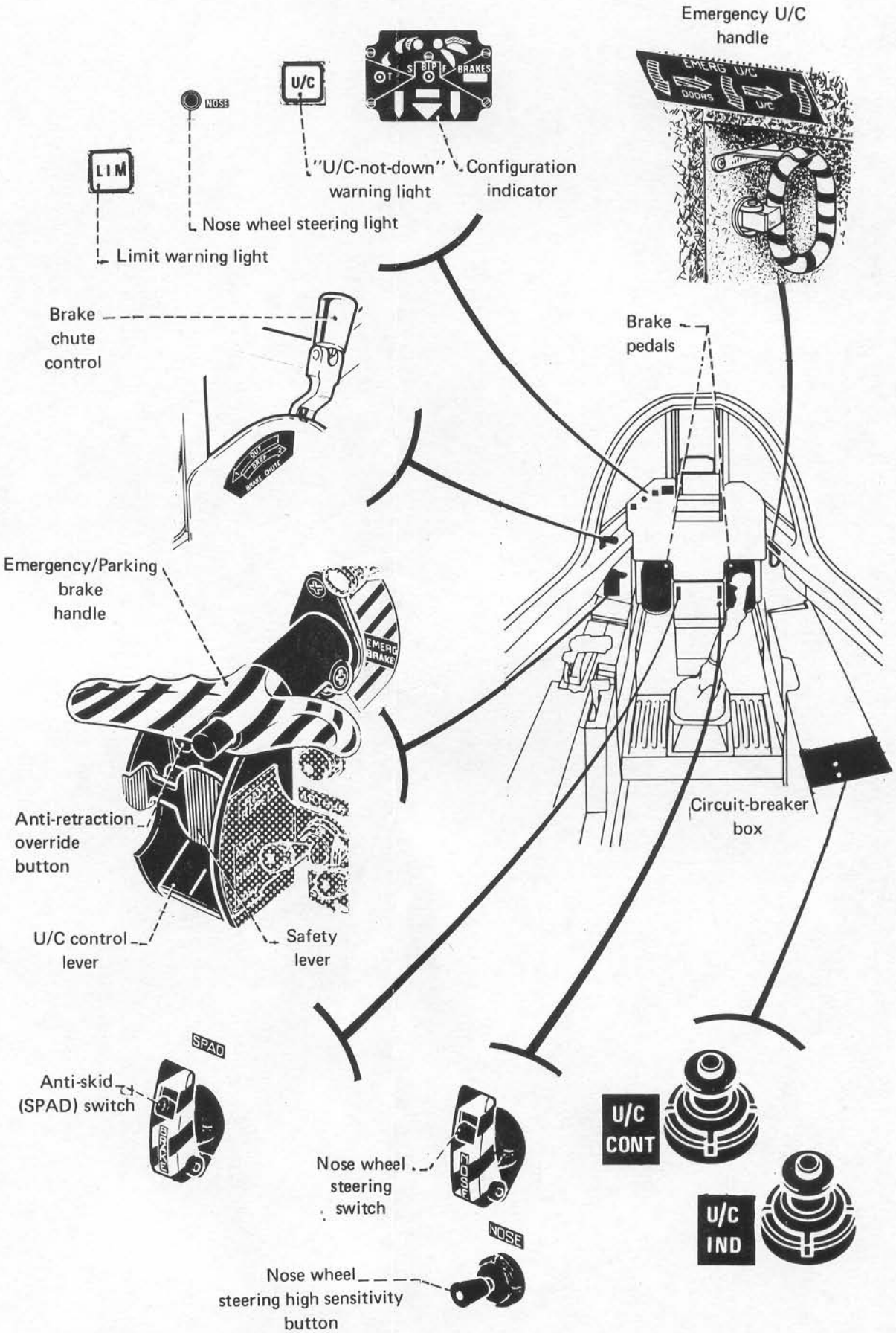


FIGURE 9 - U/C, NOSE WHEEL STEERING, BRAKE, ANTI-SKID AND BRAKE CHUTE CONTROLS AND INDICATORS

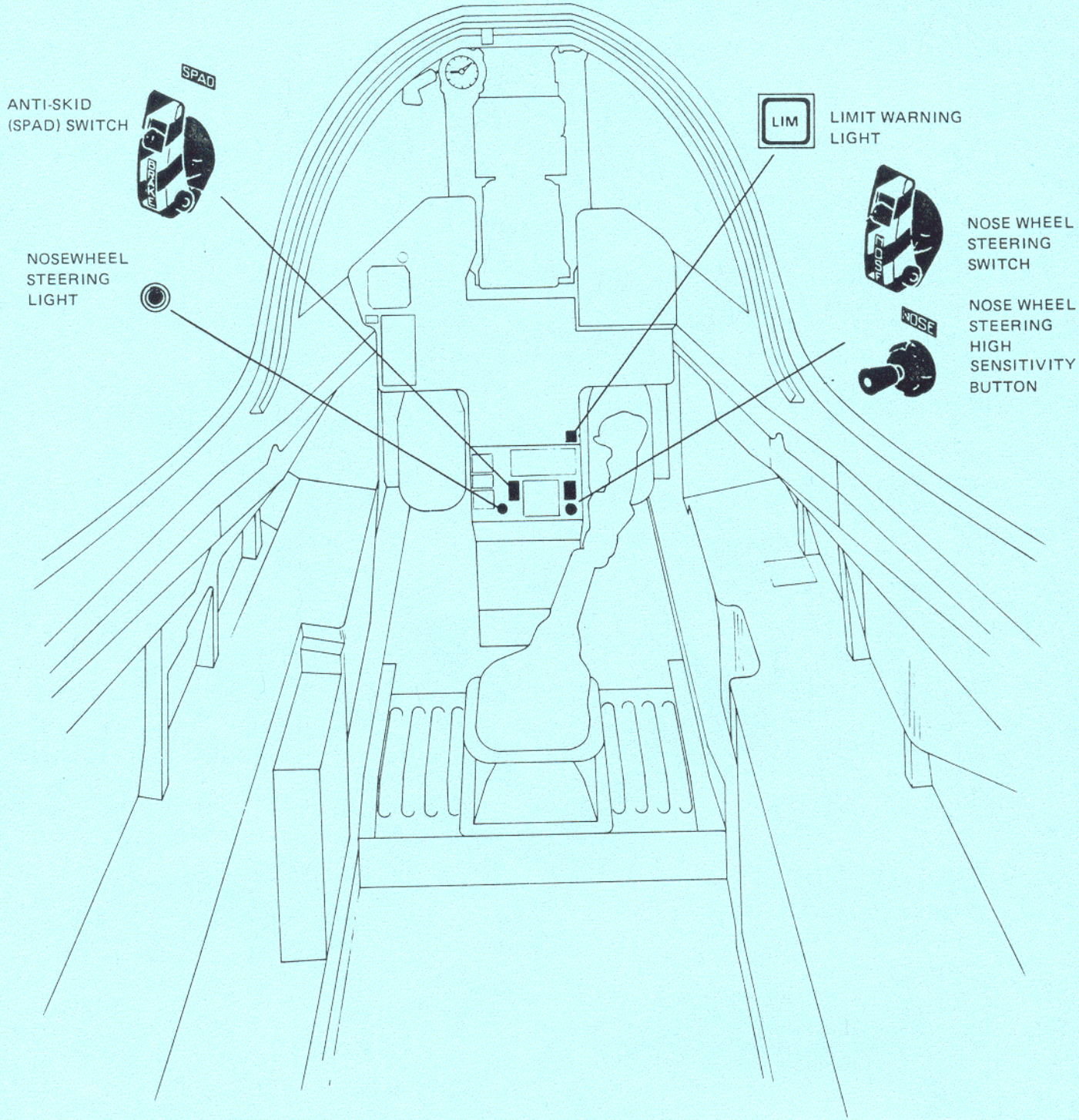


FIGURE 9A-U/C, NOSE WHEEL STEERING, BRAKE, ANTI-SKID AND BRAKE CHUTE CONTROLS AND INDICATORS (POST/SAAF/MOD/MIR/282)

1,45 – FLIGHT INSTRUMENT SYSTEMS

1,45 - FLIGHT INSTRUMENT SYSTEMS

1,45.1 - HEADING AND VERTICAL REFERENCE SYSTEM AND STANDBY HORIZON

1,45.1.1 - CONTROLS AND INDICATORS

WARNING : This paragraph gives only a brief description of the instruments. They are dealt with in greater detail in the NWS.

ITEM	NAME	DESCRIPTION	REMARKS
GYRO SYSTEM AND MAGNETIC MONITORING UNIT (MMU)	Heading control unit	4-position selector switch "OFF" = off "GM" = gyromagnetic heading "MH" = magnetic heading "EMG" = emergency gyromagnetic heading	
		2-position "GYRO" failure indicator	
		Striped red and white	Gyro system failure
		"ON"	Gyro system normal operation
		2-position "HDG" failure indicator	
		Striped red and white	MMU failure
		"ON"	MMU normal operation
	Circuit-breaker	"GYRO"	Heading control unit power supply protection
EMERGENCY GYROMAGNETIC COMPASS	Heading control unit	3-position selector switch "OFF" = off "ON" = on "ERECT" = fast erection	
		Heading error indicator	Monitors emergency gyromagnetic heading alignment
STANDBY HORIZON	Standby horizon switch		Energization control
	Uncage and aircraft model control	Rotating knob on the instrument	
	Flag	Striped	Failure or not uncaged
SPHERICAL INDICATOR	Ball		Displays pitch, roll and heading information
	Flag	Striped red and black	Vertical failure
NAVIGATION INDICATOR	Moving compass card		Displays heading information

1,45.1.2 - DESCRIPTION

The heading and vertical reference system is composed of :

- a gyro system
- a roll/pitch output multiplier
- a magnetic monitoring unit (MMU)
- an emergency gyromagnetic compass
- two flux valves
- a heading control unit
- a spherical indicator

1,45.1.3 - OPERATION

1 - INFORMATION DISTRIBUTION

The heading and vertical reference system distributes information to the flight instruments and to various items of the aircraft equipment.
The gyro system supplies vertical reference information directly to the spherical indicator, the output multiplier and the autopilot.
The output multiplier distributes roll and pitch information to the sight and the radar.

The directional heading information (from the gyro system) and the magnetic heading information (from a flux valve) are transmitted to a magnetic monitoring unit (MMU) which generates a gyromagnetic or magnetic heading and distributes it to the spherical indicator, the navigation indicator compass card, the sight, the autopilot, the TACAN and the VOR.

When the selector switch is set to "EMG" or "OFF", the MMU outputs to the navigation indicator compass card and the TACAN are switched to the heading supplied by the emergency gyromagnetic compass.
The heading control unit permits selection of the various functions of the heading and vertical reference system and also its energization.

2 - SPHERICAL INDICATOR

It displays to the pilot the pitch and roll information, the gyromagnetic or magnetic headings and the deviations from a TACAN or VOR/ILS course.
It has full freedom.
The upper hemisphere, coloured grey, represents the sky.
The lower hemisphere, coloured black, represents the Earth.
The meridians and parallels are engraved in 10° intervals.
The headings are marked at 30° intervals.
A roll index at the bottom gives the bank angle.
The aircraft model is not adjustable.
A sideslip ball is provided at the base of the instrument.
A selector switch enables the ball to be locked at the south pole in case of failure.
A flag appears to indicate vertical reference failure ; it is biased out of view approximately 2 minutes after energization of the system.
The heading displayed is always the exact heading, even at high roll or pitch angles.
During a loop, the roll index is inverted when the aircraft goes through the vertical position.

By selecting the appropriate positions on the omnibearing and VOR/ILS-TACAN selector, two pointers (vertical and horizontal) and a "TO-FROM" flag can be made to appear, giving :

- in the VOR/TAC mode : deviation from the present beacon bearing in relation to the selected approach bearing
- in the ILS mode : aircraft deviations in relation to the glide path and localizer beams.

An "ND" light flashes as the aircraft passes over marker beacons.

3 - STANDBY HORIZON

Independent of the gyro system, the standby horizon gives the pilot pitch and roll information.
The lower half-cylinder (negative angles : dive) is coloured dull black.
The upper half-cylinder (positive angles : climb) is coloured dull grey.
Parallels are marked at 10° intervals to facilitate attitude reading.
A roll index, on the lower section of the instrument, moves in front of a scale.
A failure warning flag appears on the L/H side : it is biased out of view 50 seconds after energization and horizon uncaging.

1,45.1.4 - FAILURES

1 - SPHERICAL INDICATOR MALFUNCTION (with or without flag)

This may be caused by the gyro system or by the spherical indicator itself.

- If the spherical indicator flag appears and the sight attitude reticle (horizon) is present : it is a failure of the spherical indicator
  After pole setting the spherical indicator, the normal heading is read on the navigation indicator ; the autopilot, etc., remains serviceable.
- If the spherical indicator flag appears and the sight horizon has disappeared : it is a failure of the gyro system. After pole setting and switching to emergency gyromagnetic heading, the emergency heading is read on the navigation indicator ; the autopilot is unserviceable.
- If the sight horizon has disappeared without the spherical indicator flag appearing : it is a failure of the sight or roll/pitch output multiplier (in this case, radar operation may be affected if there is a failure of the servo system : see scope vertical error). The autopilot, TACAN system, etc., remain serviceable.

2 - "GYRO" FAILURE INDICATOR VISIBLE

The autopilot disengages, or cannot be engaged.

- Switch the gyro system to "EMG".
  If the emergency heading is correct on the spherical indicator and the navigation indicator, the autopilot is still available.

3 - "HDG" FAILURE INDICATOR VISIBLE

This is a failure of the MMU.

- Read the emergency heading on the navigation indicator only.
- The autopilot is unserviceable.

4 - STANDBY HORIZON FLAG VISIBLE

The flag indicates that the standby horizon is not energized or that it has not been uncaged after energization.

FIGURE 1 – HEADING AND VERTICAL REFERENCE SYSTEM
AND STANDBY HORIZON

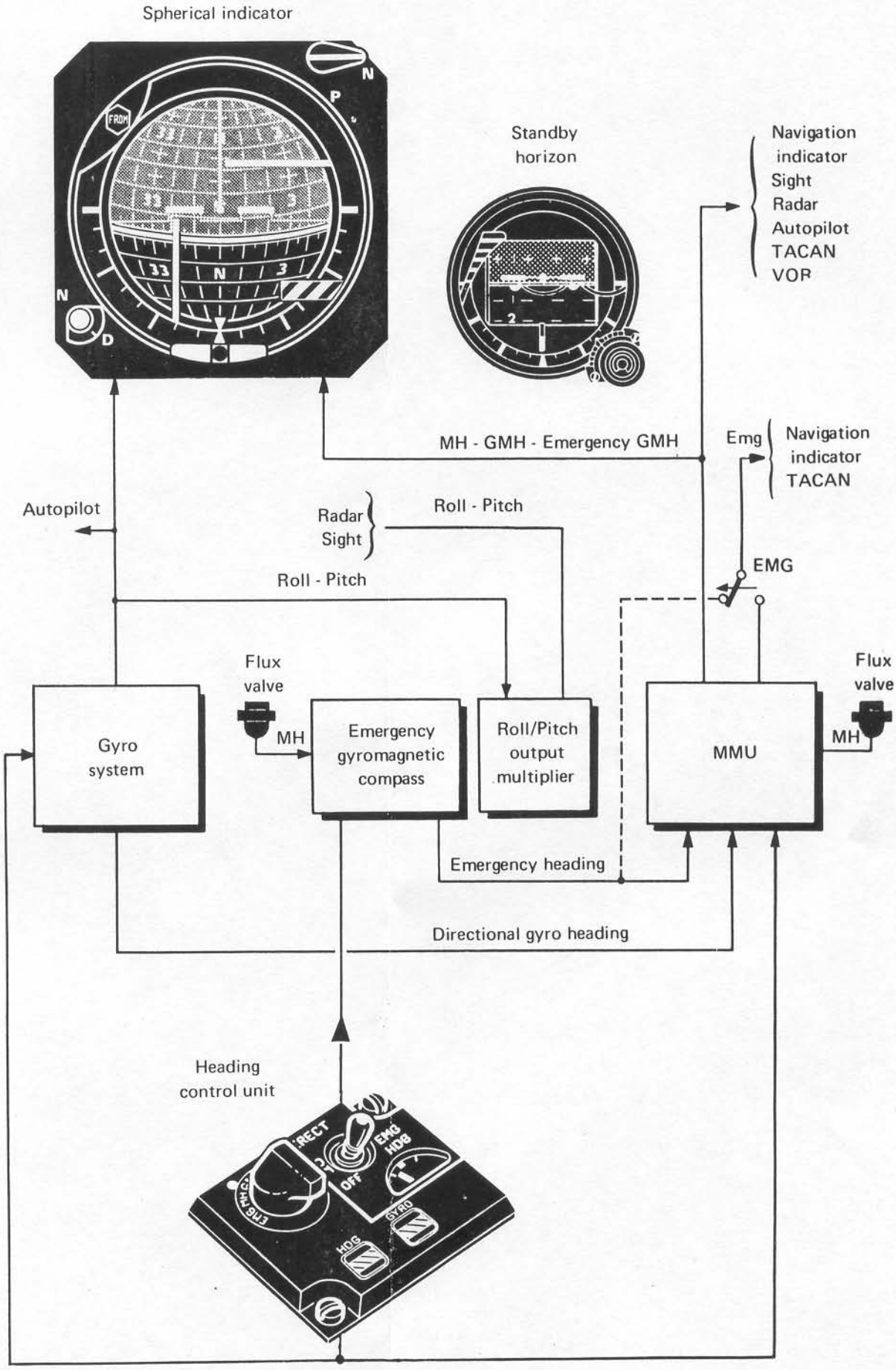


FIGURE 1 - HEADING AND VERTICAL REFERENCE SYSTEM AND STANDBY HORIZON

FIGURE 2 – HEADING AND VERTICAL REFERENCE SYSTEM
AND STANDBY HORIZON CONTROLS
AND INDICATORS

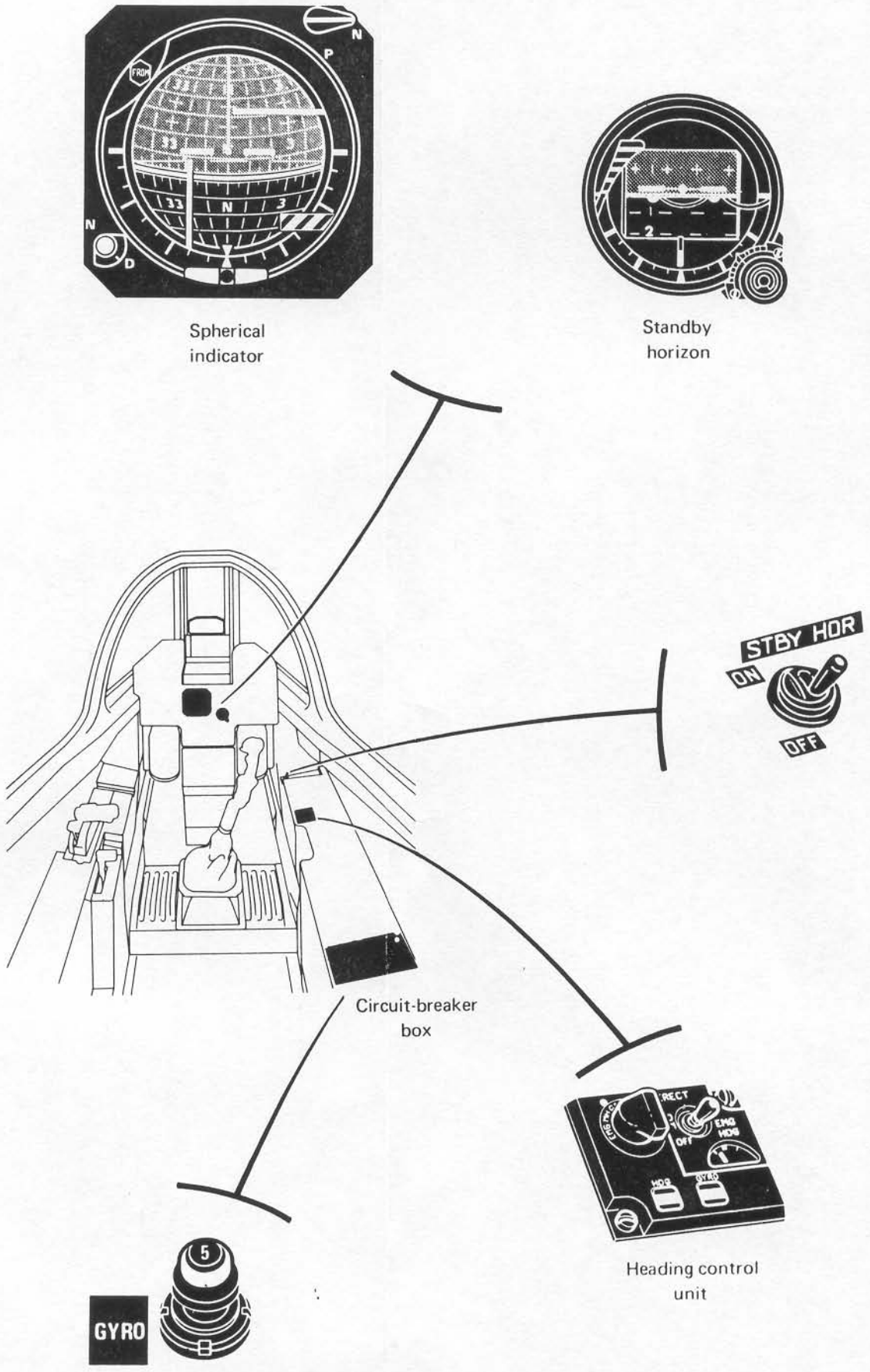


FIGURE 2 - HEADING AND VERTICAL REFERENCE SYSTEM AND STANDBY HORIZON CONTROLS AND INDICATORS

1,45.2 - AIR DATA SYSTEM AND MISCELLANEOUS INSTRUMENTS

WARNING

This paragraph gives only a brief description of the equipment. It is dealt with in greater detail in Book 2.

1,45.2.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
PITOT STATIC SYSTEM	Probe heater switch	2 positions	S1, S2, T1 and i heated by DC power - T2 heated by AC power - S3 and S4 not heated
	PITOT light	Amber	
AIR DATA COMPUTER AND SLAVED ALTIMETER	Barometric pressure setting knob		
	ADC light	Amber	
MACH/AIRSPEED INDICATOR	Moving index control knob		
STANDBY ALTIMETER	Barometric pressure setting knob		
VERTICAL SPEED INDICATOR			
INCIDENCE	Incidence indicator		
	Incidence test switch	"INCID PROBE" 3 positions	
MISCELLANEOUS INSTRUMENTS	Standby magnetic compass		
	Clock		
	Accelerometer		

1,45.2.2 - GENERAL

The system provides information for the flight instruments and the associated equipment.
The pitot and static pressures are collected by probes located on the forward fuselage section (Fig. 4).
The static and pitot probes are electrically heated.
In addition, a temperature probe provides the information required for air data computer operation.

1,45.2.3 - PROBE AND INLET ARRANGEMENT

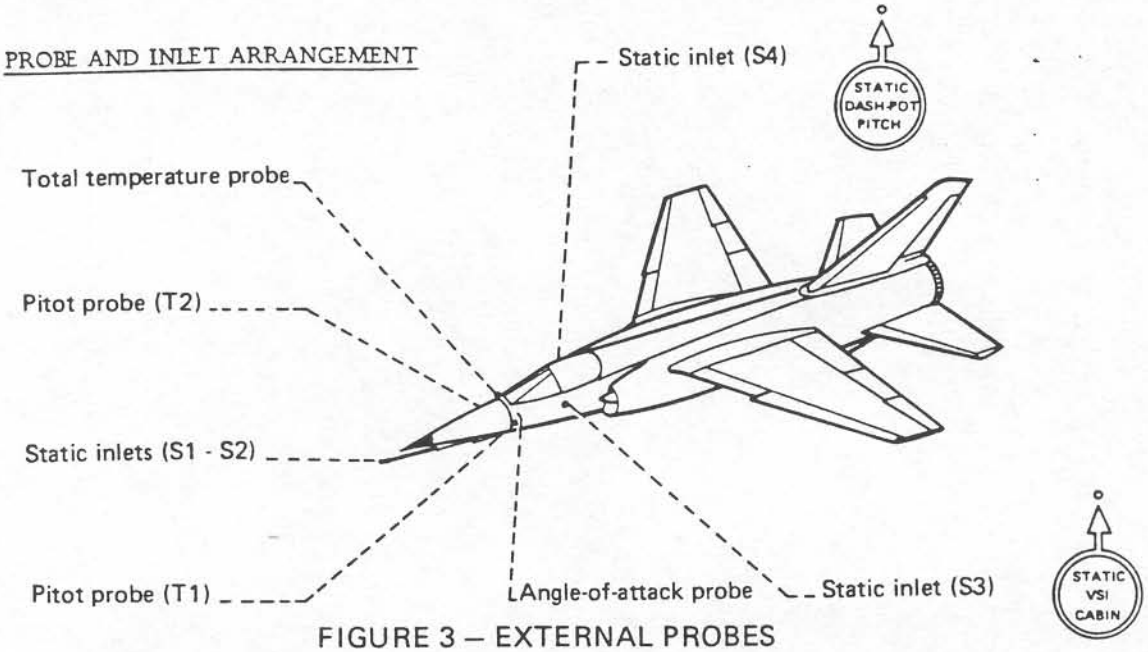


FIGURE 3 – EXTERNAL PROBES

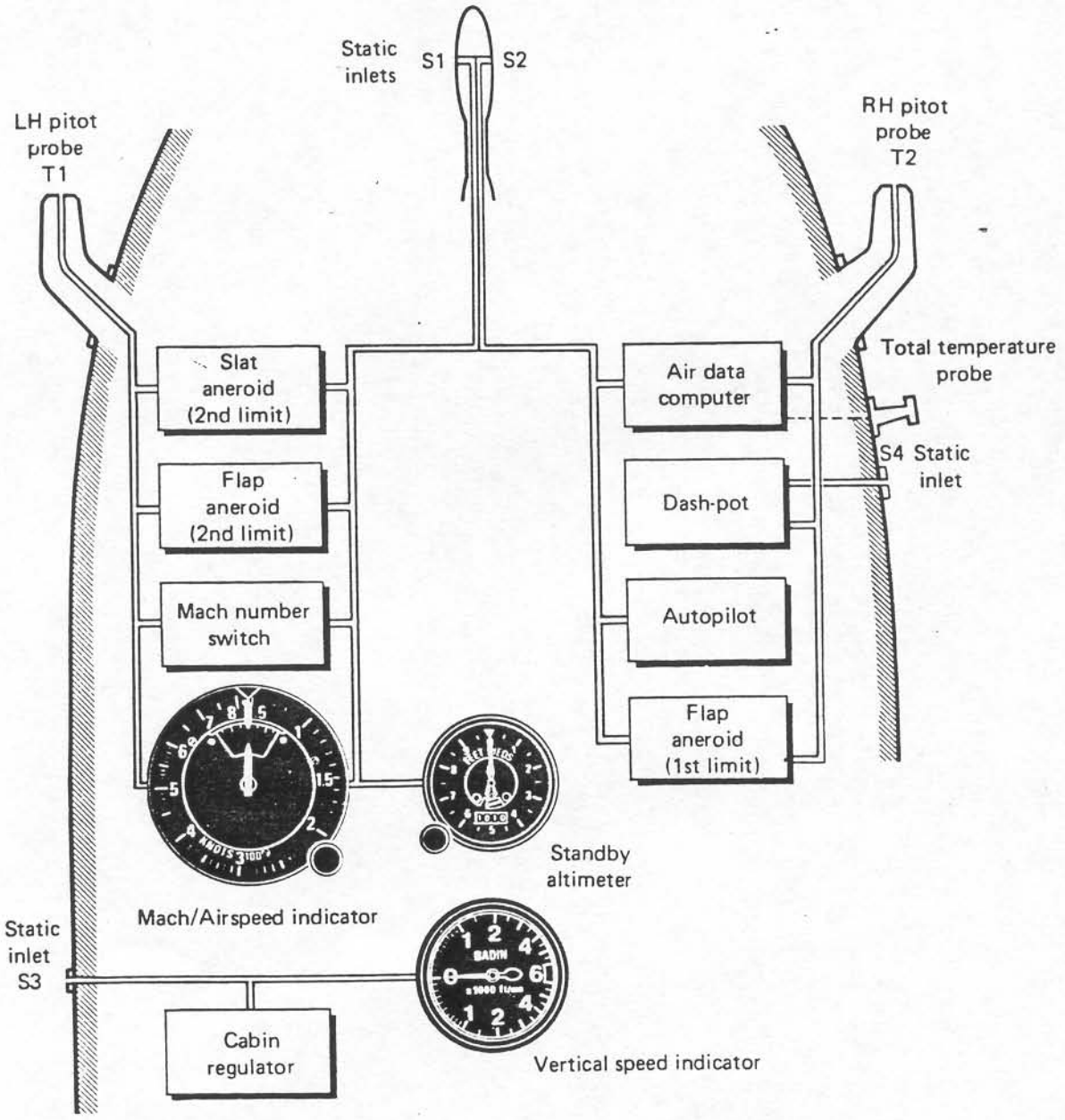


FIGURE 4 – DATA DISTRIBUTION

1,45.2.4 - AIR DATA COMPUTER AND SLAVED ALTIMETER

The air data computer constitutes the processing, computation and distribution unit for the parameters related to aircraft displacement.
These parameters are the following :

- static pressure (Ps) } collected by the pitot static system
- pitot pressure (Pt) }
- total temperature, collected by the total temperature probe.

Conversion of these parameters into electrical signals, usable by the computing channels, is made as follows :
on the one hand : by Ps and Pt pickoffs which deliver a DC voltage related to the measured parameter
on the other hand : by the temperature probe and its associated electrical circuit which provides a voltage proportional to $\sqrt{Tt}$.

The servo systems repeating the parameters generated by the air data computer are monitored by monitors which provide failure information when the error voltage of the monitored servo systems exceeds a given threshold during a period of two seconds.

The failure information results in an individual warning signal to the concerned aircraft system and in the illumination of the ADC light on the failure warning panel.

SLAVED ALTIMETER

This instrument repeats altitude information computed by the air data computer and transmits it to the IFF transponder and to the sight computer.
The altitude is displayed by :

- a pointer which makes one revolution every 1000 ft
- a four-drum counter which indicates the tens, hundreds, thousands and tens-of-thousands of feet up to 75,000 ft (mechanical stop)
  - . at H < 10,000 ft, the figure for the tens-of-thousands of feet is replaced by white stripes against a black background
  - . at H < 0 ft, a black and white striped cover masks the lower section of the four drums.
- a red and white striped flag masks the four drums in case of failure of the instrument or of the air data computer.

The control knob is used to set the pressure in millibars from 930 to 1070 mb (27.46 to 31.59 in.Hg) to an accuracy of 0.5 mb (0.015 in.Hg) on a four-figure counter.

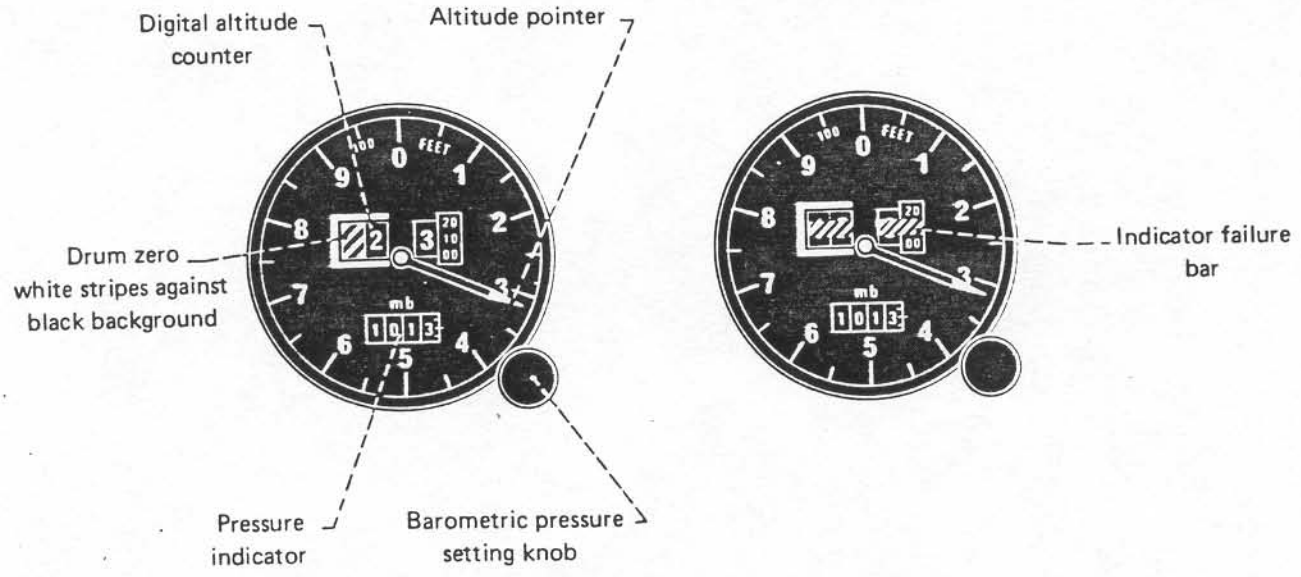


FIGURE 5 – SLAVED ALTIMETER

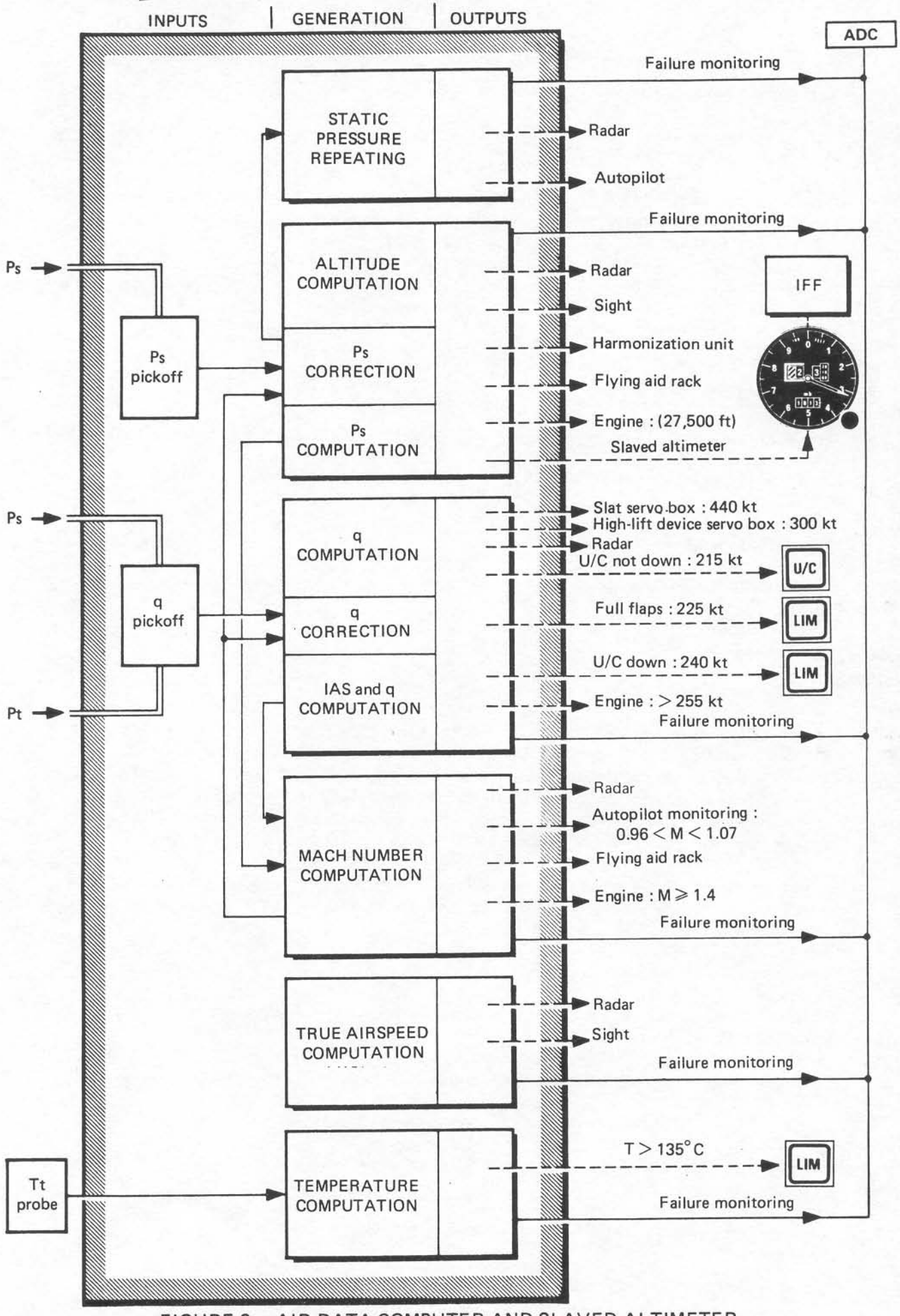


FIGURE 6 – AIR DATA COMPUTER AND SLAVED ALTIMETER

1,45.2.5 - MACH/AIRSPEED INDICATOR

This instrument permits simultaneous readout of the following :

- calibrated airspeed (in kt) on the outer dial
- Mach number on the inner dial.

The Mach number dial rotates in relation to the static pressure variations ; the double-pointed pointer rotates in front of both dials in relation to the difference between the pitot pressure and the static pressure.

In addition, the instrument includes a detection system and an electronic system which operate a built-in relay at a Mach number of 1.1 (See Chapter 1,40, Fig. 2).

A moving index, controlled by a knurled knob, allows selection of a reference speed.

1.45.2.6 - STANDBY ALTIMETER

Of the three-pointer type, it has a black and white hatched sector which is completely visible at altitudes $< 10{,}000$ ft and completely invisible at altitudes $> 26{,}000$ ft.
The reference pressure range is from 870 to 1050 mbar.

1,45.2.7 - VERTICAL SPEED INDICATOR

Its indications cover the ± 6000 ft/min range ; its readings are accurate in the absence of sideslip.

1,45.2.8 - ANGLE-OF-ATTACK INDICATOR

The angle-of-attack indicator is attached to the LH windshield post.

The purpose of the instrument is :

- to permanently display indicated angle-of-attack information
- to display by lighted indications paravisual indicated angle-of-attack information
- to retransmit to the relevant equipment a corrected angle of attack in electrical form
- to close contacts when the local angle of attack exceeds given limits

In operation, the local angle-of-attack information transmitted by the probe through synchros is repeated by a servo system inside the indicator. The servo system transforms the local angle-of-attack information into corrected angle-of-attack information by means of a gear train.

The angle-of-attack indicator displays the information as follows :

The indicated angle of attack appears in the form of a white thermometer-type strip which moves opposite a fixed readout scale.

This scale has white numbers every five degrees and each degree is marked by a line ; the readout range is from 0 to 22°.

A window at the top of the white strip shows 3° angle-of-attack ranges.

Three of the ranges are lighted and are illuminated when the corrected angle of attack exceeds 8° ; their limits are :

- red between 22° and 15.5°
- yellow between 15.5° and 12.5°
- green between 12.5° and 9.5°

There is an unlighted blue range between 9.5° and 6°.

The color of each range is recalled by a thin fluorescent paint line of the corresponding color on the LH edge.

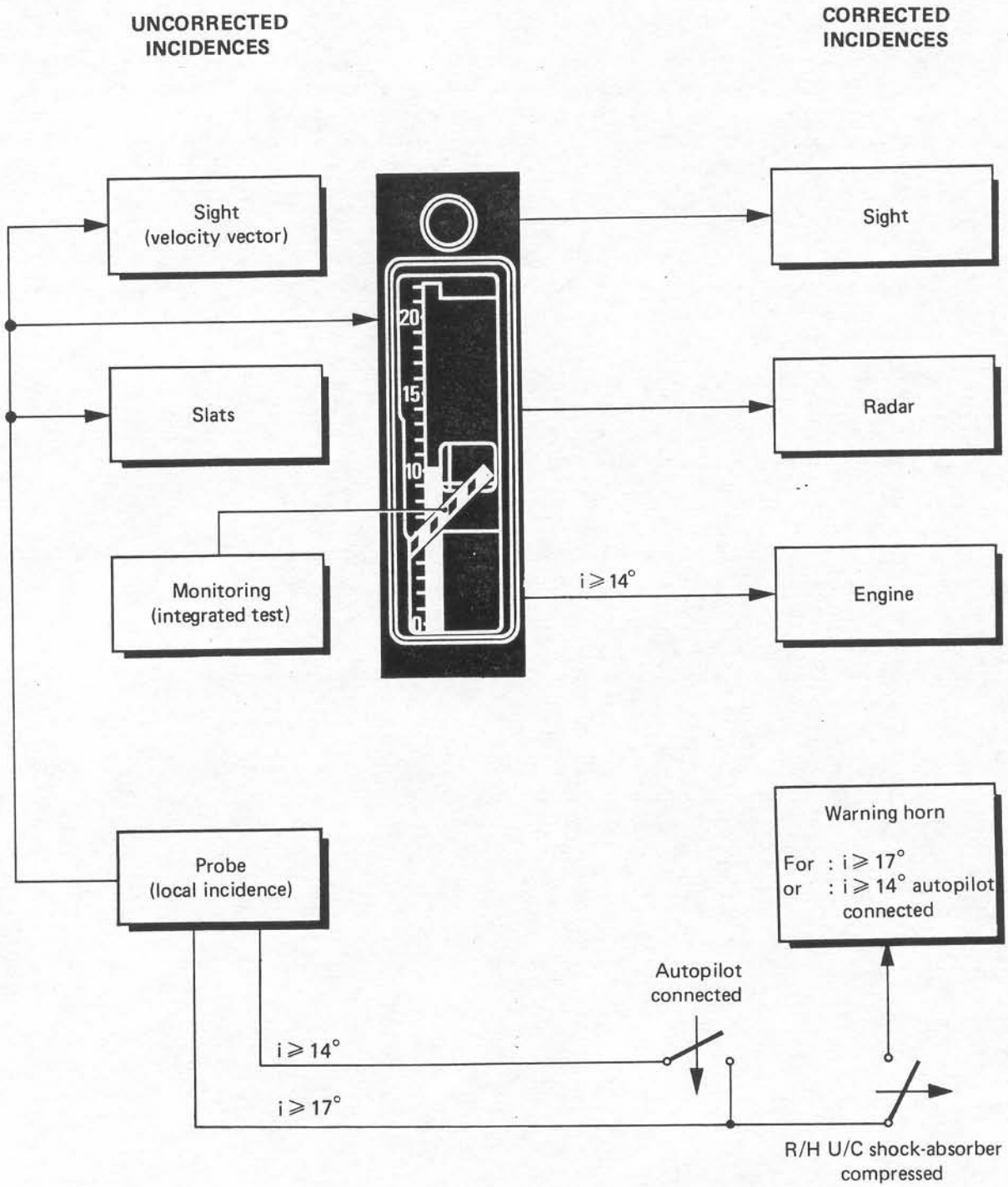


FIGURE 6 – INCIDENCE INDICATOR

The intensity of the lighted ranges can be adjusted by a potentiometer at the top of the indicator.

The incidence indicator is also provided with integral lighting (See para. 1, 50. 2).

A black striped red flag appears in case of lack of power supply or servo failure. The flag may also appear due to rapid probe movements and strong turbulence.

The i $>$ 17° limit incidence is indicated by the warning horn (special signal) ; this limit incidence is reduced to 14° when the autopilot is connected. An anticipation, which takes account of the incidence change rate, may activate the warning horn before the limit is reached : for an incidence change rate of 10°/sec., the anticipation is 2° approximately ; the warning horn will then sound at 15°. The frequency of the warning horn signal increases between 15 and 17° according to the incidence angle and the incidence angle change rate.
The same anticipation occurs when the autopilot is connected. The warning horn is cut off as long as the R/H U/C shock-absorber is compressed.

The incidence test switch enables the position of the probe to be varied and thus to check the satisfactory operation of the assembly (although the R/H shock-absorber is compressed, the warning horn operates in this case).

1,45.2.9 - MISCELLANEOUS INSTRUMENTS

1 - STANDBY MAGNETIC COMPASS

This is a magnetic compass with a graduated circular dial which indicates the magnetic heading.

2 - CLOCK

This is a chronometer type clock comprising, in addition to a standard clock, a small pointer which indicates elapsed time on a dial from 0 to 15 minutes.
It is provided with :

- a chronometer starting control
- a lever associated with a knob for winding it up and setting it to the correct time.

3 - ACCELEROMETER ("g"-meter)

This linear instrument has three pointers, one of which indicates the instantaneous acceleration value and the other two the maximum positive and negative values attained.
These two pointers can be aligned on the main pointer by means of a resetting button.

1, 45. 2. 10 - FAILURES

PITOT light on

This light indicates a failure of the L/H pitot probe or static pressure probe heating, or that the probe heater switch is off.

NOTE : The incidence probe and the R/H pitot probe have no heating failure indicating system.

ADC light on

Failure of the air data computer.
The autopilot disengages, or cannot be engaged.
The flying aid gains are frozen, in particular :
- the shock-cones and the ARTHUR remain in the positions existing at the time of failure.
- according to the type of failure, the following may be lost, or operate untimely :
  - A/B overboost
  - overspeed
  - limit warning light
  - the slaved altimeter, flag visible, ceases to transmit coded altitude to the IFF
  - the combat high-lift devices (the second interlock remains operative).

FIGURE 8 – AIR DATA SYSTEM CONTROLS AND INDICATORS AND MISCELLANEOUS INSTRUMENTS

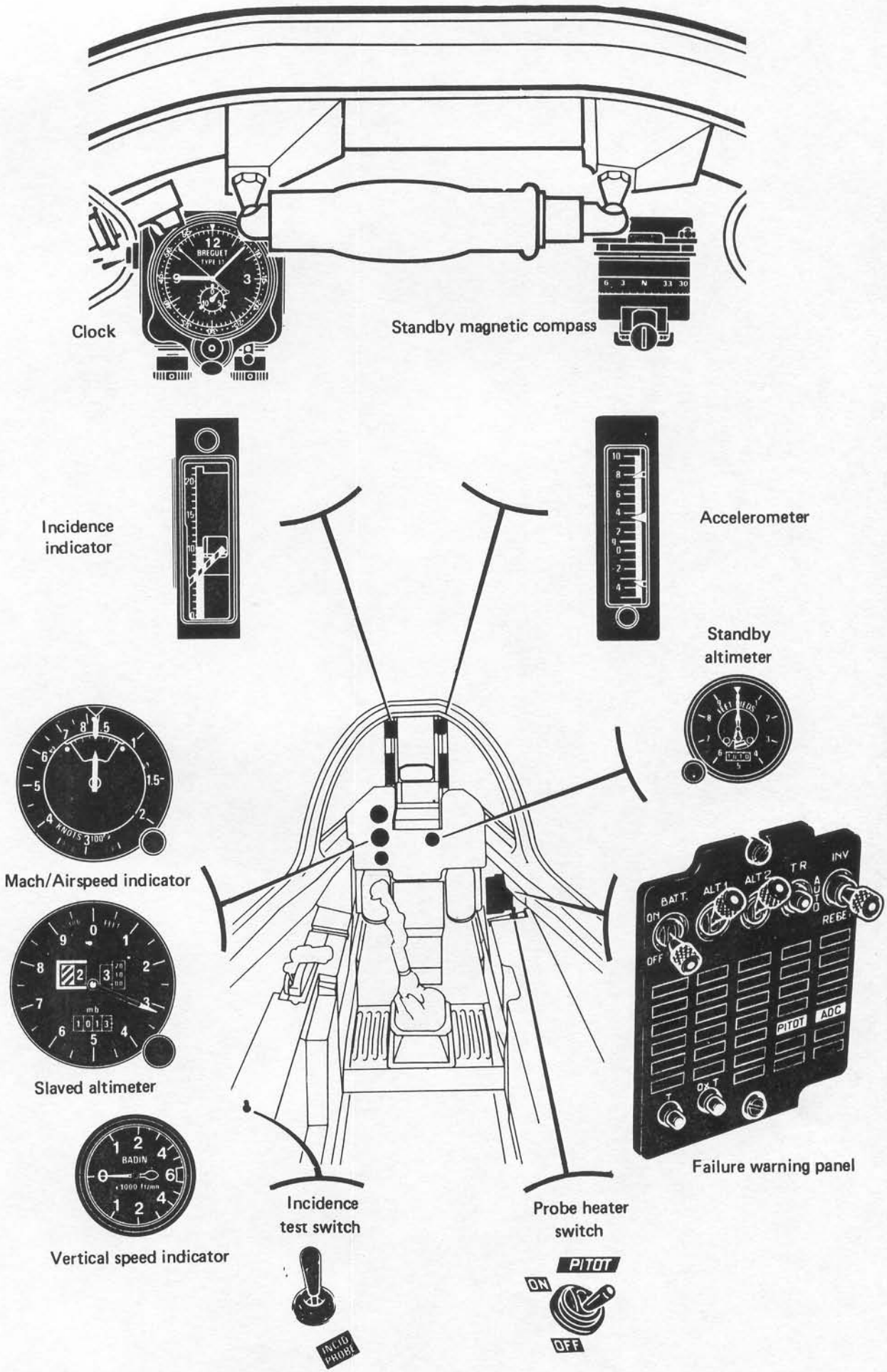


FIGURE 8 – AIR DATA SYSTEM CONTROLS AND INDICATORS AND MISCELLANEOUS INSTRUMENTS

1,45.2 - AIR DATA SYSTEM AND MISCELLANEOUS INSTRUMENTS WARNING

This paragraph gives only a brief description of the equipment. It is dealt with in greater detail in Book 2.

1,45.2.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
PITOT STATIC SYSTEM	Probe heater switch	2 positions	S1, S2, T1 and i heated by DC power - T2 heated by AC power - S3 and S4 not heated
	PITOT light	Amber	
AIR DATA COMPUTER AND SLAVED ALTIMETER	Barometric pressure setting knob		
	ADC light	Amber	
MACH/AIRSPEED INDICATOR	Moving index control knob		
STANDBY ALTIMETER	Barometric pressure setting knob		
VERTICAL SPEED INDICATOR			
INCIDENCE	Incidence indicator		
	Incidence test switch	"INCID PROBE" 3 positions	
MISCELLANEOUS INSTRUMENTS	Standby magnetic compass		
	Clock		
	Accelerometer		

1,45.2.2 - GENERAL

The system provides information for the flight instruments and the associated equipment.
The pitot and static pressures are collected by probes located on the forward fuselage section (Fig. 4).
The static and pitot probes are electrically heated.
In addition, a temperature probe provides the information required for air data computer operation.

1,45.2.3 - PROBE AND INLET ARRANGEMENT

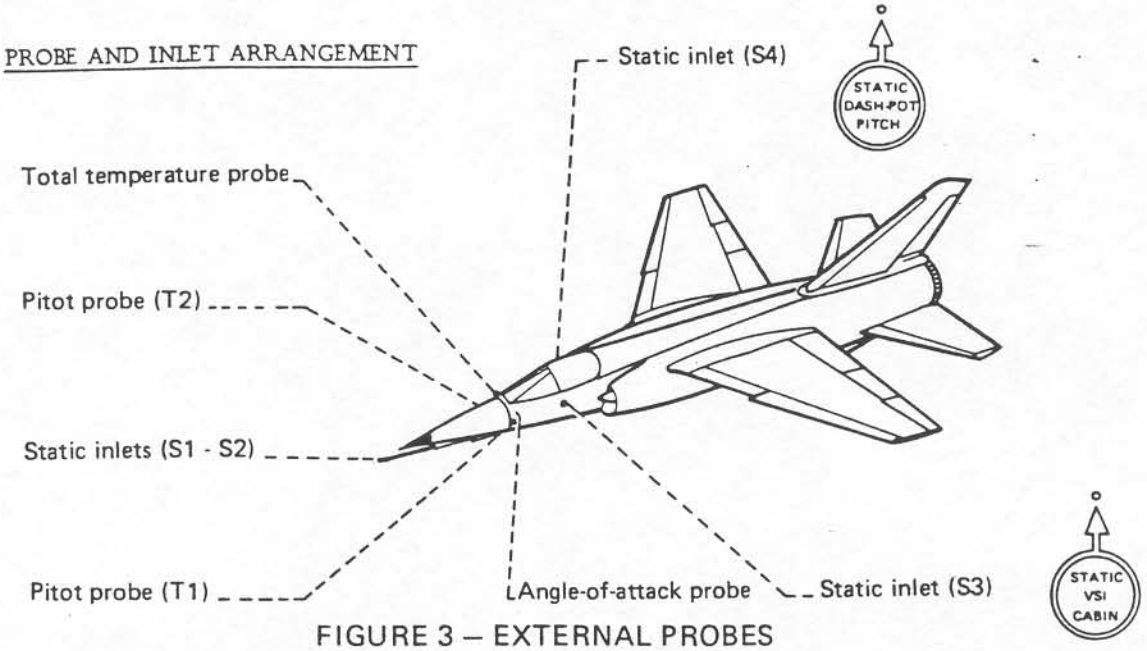


FIGURE 3 – EXTERNAL PROBES

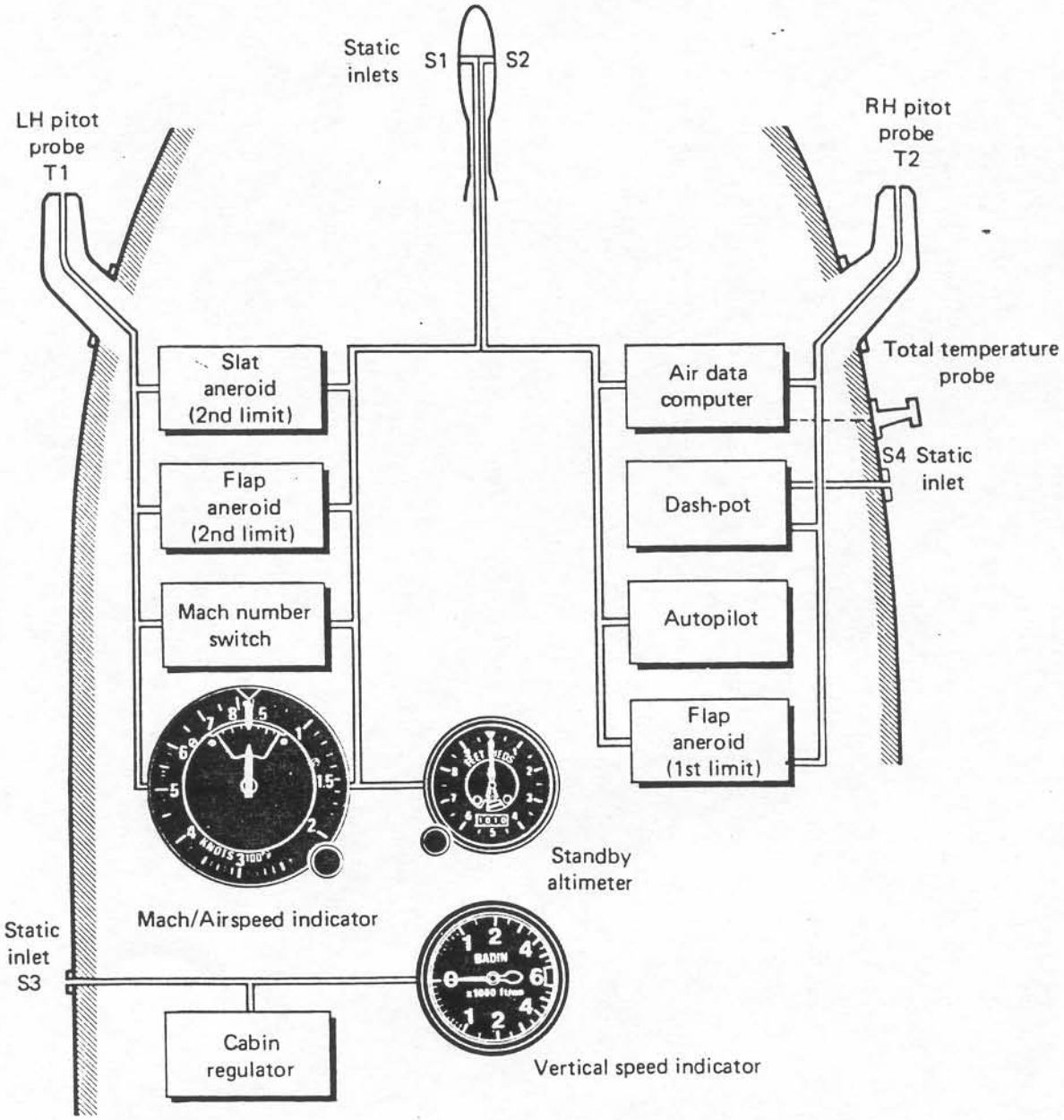


FIGURE 4 – DATA DISTRIBUTION

1,45.2.4 - AIR DATA COMPUTER AND SLAVED ALTIMETER

The air data computer constitutes the processing, computation and distribution unit for the parameters related to aircraft displacement.
These parameters are the following :

- static pressure (Ps) } collected by the pitot static system
- pitot pressure (Pt) }
- total temperature, collected by the total temperature probe.

Conversion of these parameters into electrical signals, usable by the computing channels, is made as follows :
on the one hand : by Ps and Pt pickoffs which deliver a DC voltage related to the measured parameter
on the other hand : by the temperature probe and its associated electrical circuit which provides a voltage proportional to $\sqrt{Tt}$.

The servo systems repeating the parameters generated by the air data computer are monitored by monitors which provide failure information when the error voltage of the monitored servo systems exceeds a given threshold during a period of two seconds.

The failure information results in an individual warning signal to the concerned aircraft system and in the illumination of the ADC light on the failure warning panel.

SLAVED ALTIMETER

This instrument repeats altitude information computed by the air data computer and transmits it to the IFF transponder and to the sight computer.
The altitude is displayed by :

- a pointer which makes one revolution every 1000 ft
- a four-drum counter which indicates the tens, hundreds, thousands and tens-of-thousands of feet up to 75,000 ft (mechanical stop)
  - . at H < 10,000 ft, the figure for the tens-of-thousands of feet is replaced by white stripes against a black background
  - . at H < 0 ft, a black and white striped cover masks the lower section of the four drums.
- a red and white striped flag masks the four drums in case of failure of the instrument or of the air data computer.

The control knob is used to set the pressure in millibars from 930 to 1070 mb (27.46 to 31.59 in.Hg) to an accuracy of 0,5 mb (0.015 in.Hg) on a four-figure counter.

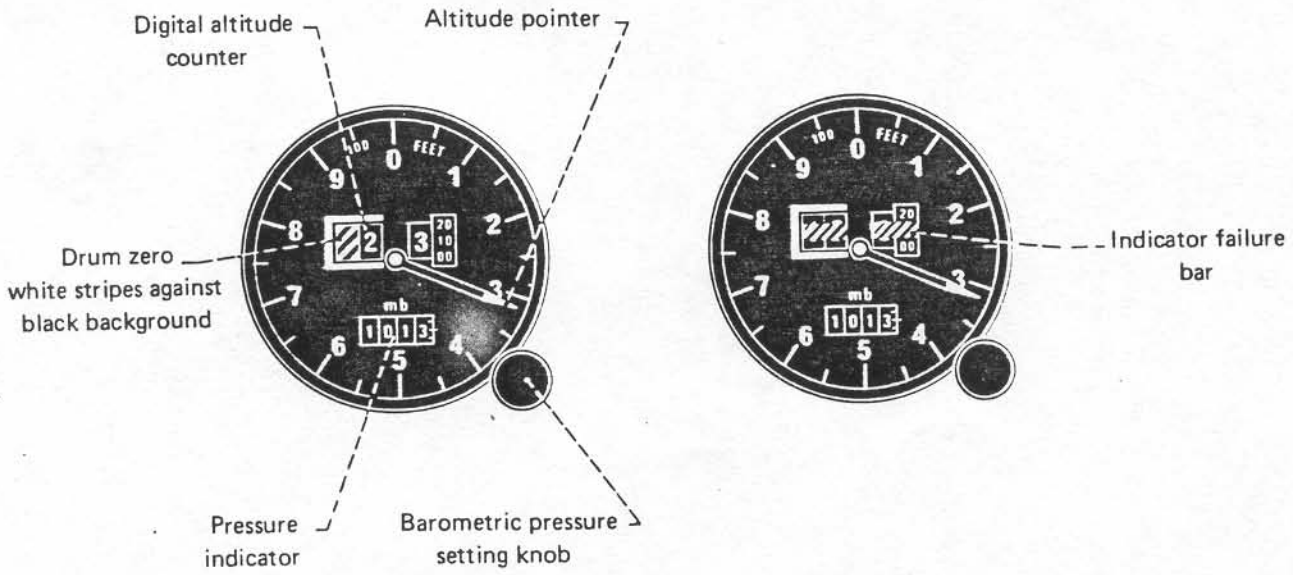


FIGURE 5 – SLAVED ALTIMETER

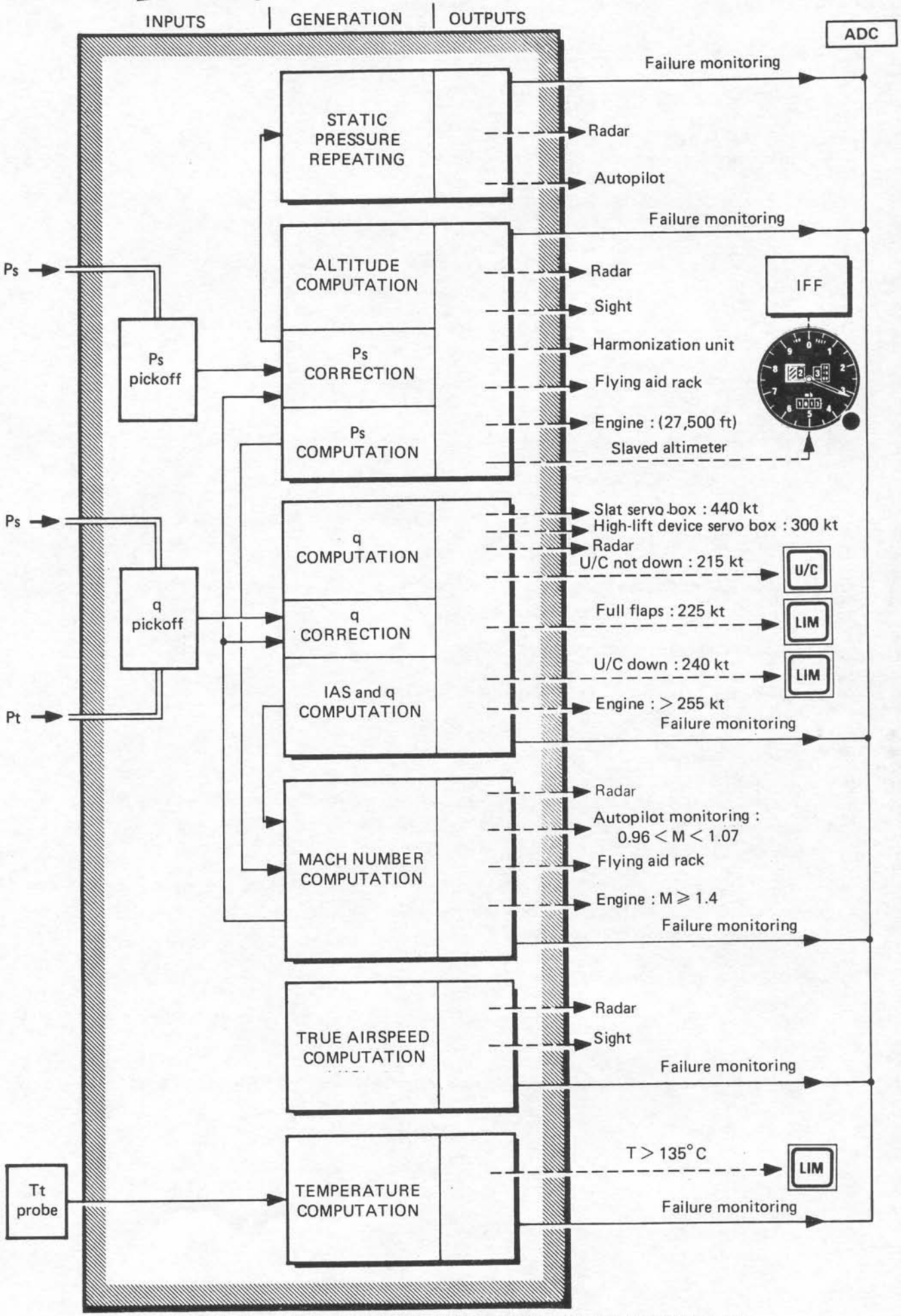


FIGURE 6 – AIR DATA COMPUTER AND SLAVED ALTIMETER

1,45.2.5 - MACH/AIRSPEED INDICATOR

This instrument permits simultaneous readout of the following :

- calibrated airspeed (in kt) on the outer dial
- Mach number on the inner dial.

The Mach number dial rotates in relation to the static pressure variations ; the double-pointed pointer rotates in front of both dials in relation to the difference between the pitot pressure and the static pressure.

In addition, the instrument includes a detection system and an electronic system which operate a built-in relay at a Mach number of 1.1 (See Chapter 1,40, Fig. 2).

A moving index, controlled by a knurled knob, allows selection of a reference speed.

1.45.2.6 - STANDBY ALTIMETER

Of the three-pointer type, it has a black and white hatched sector which is completely visible at altitudes $< 10{,}000$ ft and completely invisible at altitudes $> 26{,}000$ ft.
The reference pressure range is from 870 to 1050 mbar.

1,45.2.7 - VERTICAL SPEED INDICATOR

Its indications cover the ± 6000 ft/min range ; its readings are accurate in the absence of sideslip.

1,45.2.8 - ANGLE-OF-ATTACK INDICATOR

The angle-of-attack indicator is attached to the LH windshield post.

The purpose of the instrument is :

- to permanently display indicated angle-of-attack information
- to display by lighted indications paravisual indicated angle-of-attack information
- to retransmit to the relevant equipment a corrected angle of attack in electrical form
- to close contacts when the local angle of attack exceeds given limits

In operation, the local angle-of-attack information transmitted by the probe through synchros is repeated by a servo system inside the indicator. The servo system transforms the local angle-of-attack information into corrected angle-of-attack information by means of a gear train.

The angle-of-attack indicator displays the information as follows :

The indicated angle of attack appears in the form of a white thermometer-type strip which moves opposite a fixed readout scale.

This scale has white numbers every five degrees and each degree is marked by a line ; the readout range is from 0 to 22°.

A window at the top of the white strip shows 3° angle-of-attack ranges.

Three of the ranges are lighted and are illuminated when the corrected angle of attack exceeds 8° ; their limits are :

- red between 22° and 15.5°
- yellow between 15.5° and 12.5°
- green between 12.5° and 9.5°

There is an unlighted blue range between 9.5° and 6°.

The color of each range is recalled by a thin fluorescent paint line of the corresponding color on the LH edge.

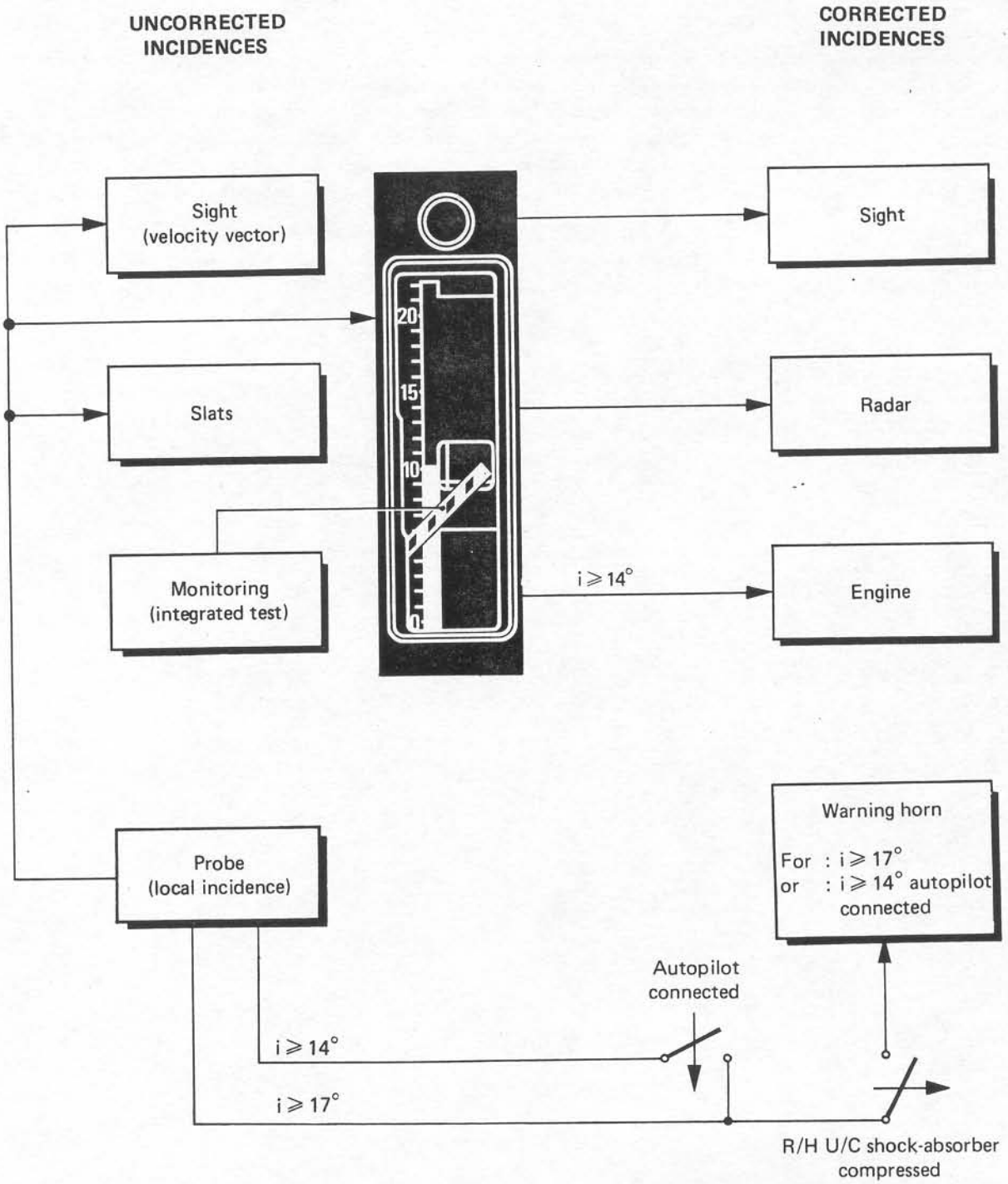


FIGURE 6 – INCIDENCE INDICATOR

The intensity of the lighted ranges can be adjusted by a potentiometer at the top of the indicator.

The incidence indicator is also provided with integral lighting (See para. 1, 50. 2).

A black striped red flag appears in case of lack of power supply or servo failure. The flag may also appear due to rapid probe movements and strong turbulence.

The $i > 17°$ limit incidence is indicated by the warning horn (special signal) ; this limit incidence is reduced to 14° when the autopilot is connected. An anticipation, which takes account of the incidence change rate, may activate the warning horn before the limit is reached : for an incidence change rate of 10°/sec., the anticipation is 2° approximately ; the warning horn will then sound at 15°. The frequency of the warning horn signal increases between 15 and 17° according to the incidence angle and the incidence angle change rate.
The same anticipation occurs when the autopilot is connected. The warning horn is cut off as long as the R/H U/C shock-absorber is compressed.

The incidence test switch enables the position of the probe to be varied and thus to check the satisfactory operation of the assembly (although the R/H shock-absorber is compressed, the warning horn operates in this case).

1,45.2.9 - MISCELLANEOUS INSTRUMENTS

1 - STANDBY MAGNETIC COMPASS

This is a magnetic compass with a graduated circular dial which indicates the magnetic heading.

2 - CLOCK

This is a chronometer type clock comprising, in addition to a standard clock, a small pointer which indicates elapsed time on a dial from 0 to 15 minutes.
It is provided with :

- a chronometer starting control
- a lever associated with a knob for winding it up and setting it to the correct time.

3 - ACCELEROMETER ("g"-meter)

This linear instrument has three pointers, one of which indicates the instantaneous acceleration value and the other two the maximum positive and negative values attained.
These two pointers can be aligned on the main pointer by means of a resetting button.

1, 45.2.10 - FAILURES

PITOT light on

This light indicates a failure of the L/H pitot probe or static pressure probe heating, or that the probe heater switch is off.

NOTE : The incidence probe and the R/H pitot probe have no heating failure indicating system.

ADC light on

Failure of the air data computer.
The autopilot disengages, or cannot be engaged.
The flying aid gains are frozen, in particular :
- the shock-cones and the ARTHUR remain in the positions existing at the time of failure.
- according to the type of failure, the following may be lost, or operate untimely :
  - A/B overboost
  - overspeed
  - limit warning light
  - the slaved altimeter, flag visible, ceases to transmit coded altitude to the IFF
  - the combat high-lift devices (the second interlock remains operative).

1,50 – COCKPIT LAYOUT

1,50 - COCKPIT LAYOUT

1,50.1 - CANOPY

1,50.1.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
LOCKING	Canopy lock control	3 positions Lever with 2 quadrants	Locking - Opening - Closing
	External control	Square drive	
EMBRITTLEMENT	Canopy embrittle control	Lever	Safetied
	External controls	2 handles under plexiglas covers	

1,50.1.2 - DESCRIPTION

The canopy is hinged at its upper rear section and is balanced by a pneumatic jack which also locks it in the open position.
Sealing is obtained through an inflatable canopy seal.
The canopy includes :

- on its upper section : - a hinged handle used to keep the canopy partially open.
  - two rear-view mirrors.
- on the RH side : - a control handle.
- on the LH side : - a canopy shear knife used to break the canopy if the embrittlement system fails to operate.

The canopy is moved by hand.
The pilot ejection system includes a canopy embrittlement device.
Embrittlement consists in producing, by means of a pyrotechnical system, cracks in the plexiglas material which then offers a very low resistance.

The device is provided with three controls :

- an automatic control in case of use of the ejection seat
- a canopy embrittle control (lever to be pushed by the pilot with his left hand)
- a pilot's rescue external control for use on the ground (two pull handles on either side of the aircraft aft of the canopy).

1,50.1.3 - EMERGENCY OPERATION

- Automatic embrittlement (seat ejection) : As the seat starts its ejection travel, a detonation wave is created in the pyrotechnical system. When this wave reaches the embrittlement points on the periphery of the canopy, it creates a series of star-shaped cracks in the dome which break the latter into relatively small pieces. When the canopy breakers of the seat hit the plexiglas material, the latter is already embrittled. The canopy pieces are lifted and taken off by the relative wind ; the pieces located right above the seat pivot about a Dacron hinge which facilitates their aft movement. The pilot and the seat pass through the canopy frame within an area free of any plexiglas material.

- Controlled embrittlement : The pilot or the ground personnel actuating the canopy embrittle control, or either external handle, causes canopy embrittlement.
  On the ground, where there is no pressure or relative wind, the dome remains in place. The pilot or ground personnel only has to push the dome away, the canopy frame staying in place.

NOTE : Operation of the embrittlement system results in a detonation and a smoke emission which are of no danger for the pilot. However, it is recommended to lower the helmet clear visor.

1,50.2 - LIGHTING

1,50.2.1 - COCKPIT LIGHTING (See Figure 1)

ITEM	NAME	DESCRIPTION	REMARKS
COCKPIT LIGHTING	«DIMMER» «DAY/NIGHT» selector switch + Light and panel lighting rheostat		Panels and lights : - armament, failures, transfer, configuration - airbrakes, limitations, fire, emergency regulation, AB, nose wheel steering (effective in night position)
	Instrument panel UV lighting rheostat Dual «INSTR. PANEL» lighting rheostat Dual «CONSOLES» lighting rheostat		- instrument panel UV lamps - external : red - internal : integral - external : red - internal : integral (internal console lighting) (partial external lighting) (two-level lighting of V/UHF control box channel markings)
	Miscellaneous instrument lighting rheostat		- standby compass - clock, accelerometer - angle-of-attack indicator tape
	Miscellaneous instrument lighting switch		Allows lighting of the angle-of-attack indicator tape only
	Map light rheostat		- map light
	Angle-of-attack indicator lighting rheostat		- angle-of-attack indicator colored lights
	Autopilot intensity control		- lighted pushbuttons
	Lead light		Supplies lighting as soon as it is removed from its housing

NOTE : In case of complete AC power failure, the emergency inverter provides lighting of the following instruments : standby compass, accelerometer, angle-of-attack indicator and clock light located at the upper part of the bow.

1,50.2.2 - EXTERIOR LIGHTING (See Figure 2)

ITEM	NAME	DESCRIPTION	REMARKS
LANDING LIGHT	Landing light control	3 positions «OFF» - «LAND» - «TAXY»	- Can be operated only when the nose U/C is down
SEARCHLIGHT	Searchlight switch	2 positions «ON» - «OFF»	See Operational Equipment Section
	Searchlight button		
FORMATION LIGHT	Formation light selector switch	3 positions Dim - Off - Bright	
POSITION LIGHTS	Position light selector switch	3 positions Dim - Off - Bright	- On bright, the lights are flashing - On dim, the lights are steady with lower intensity

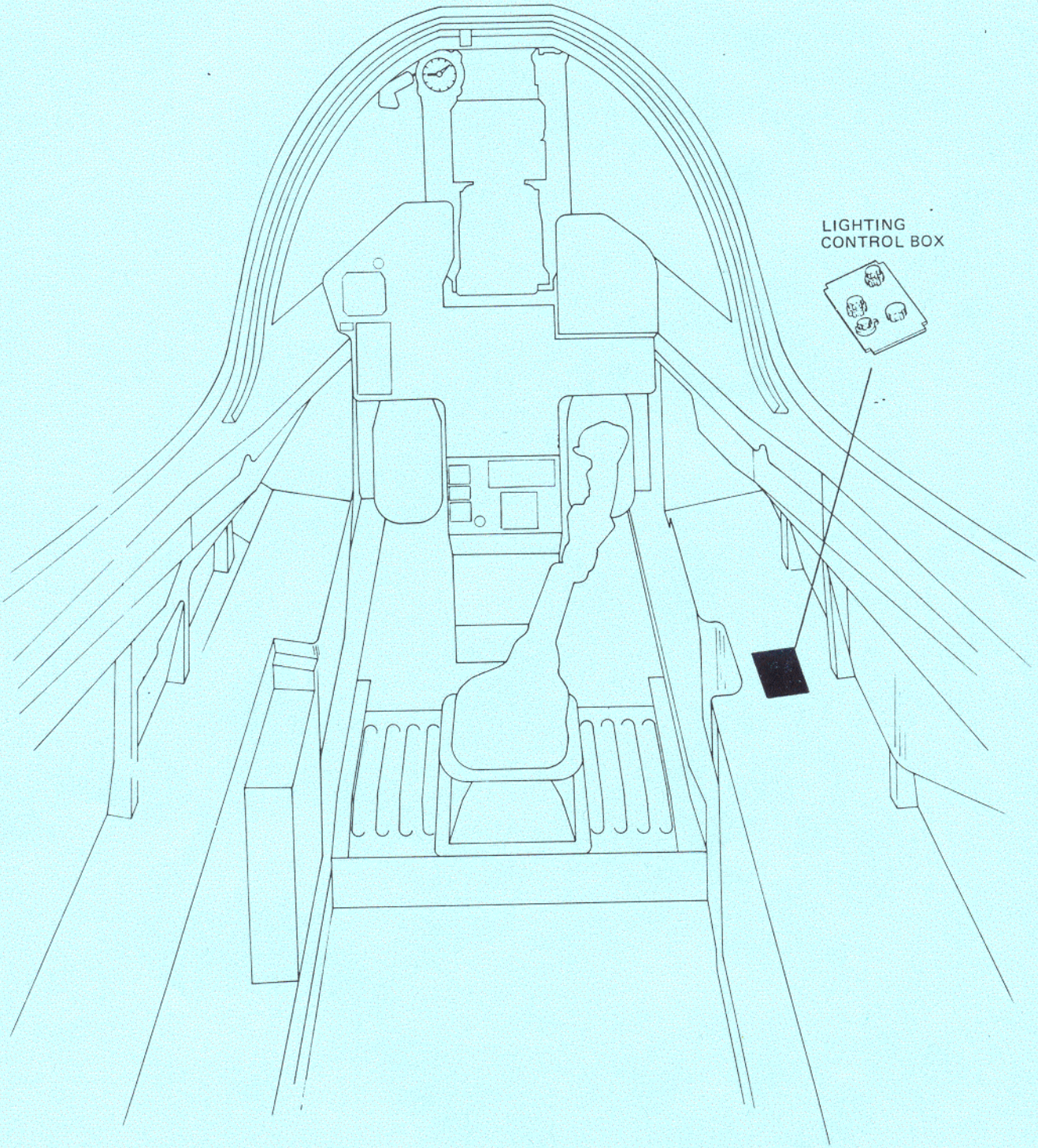


FIGURE 1A – COCKPIT LIGHTING
(POST/SAAF/MOD/MIR/282)

TP 0575

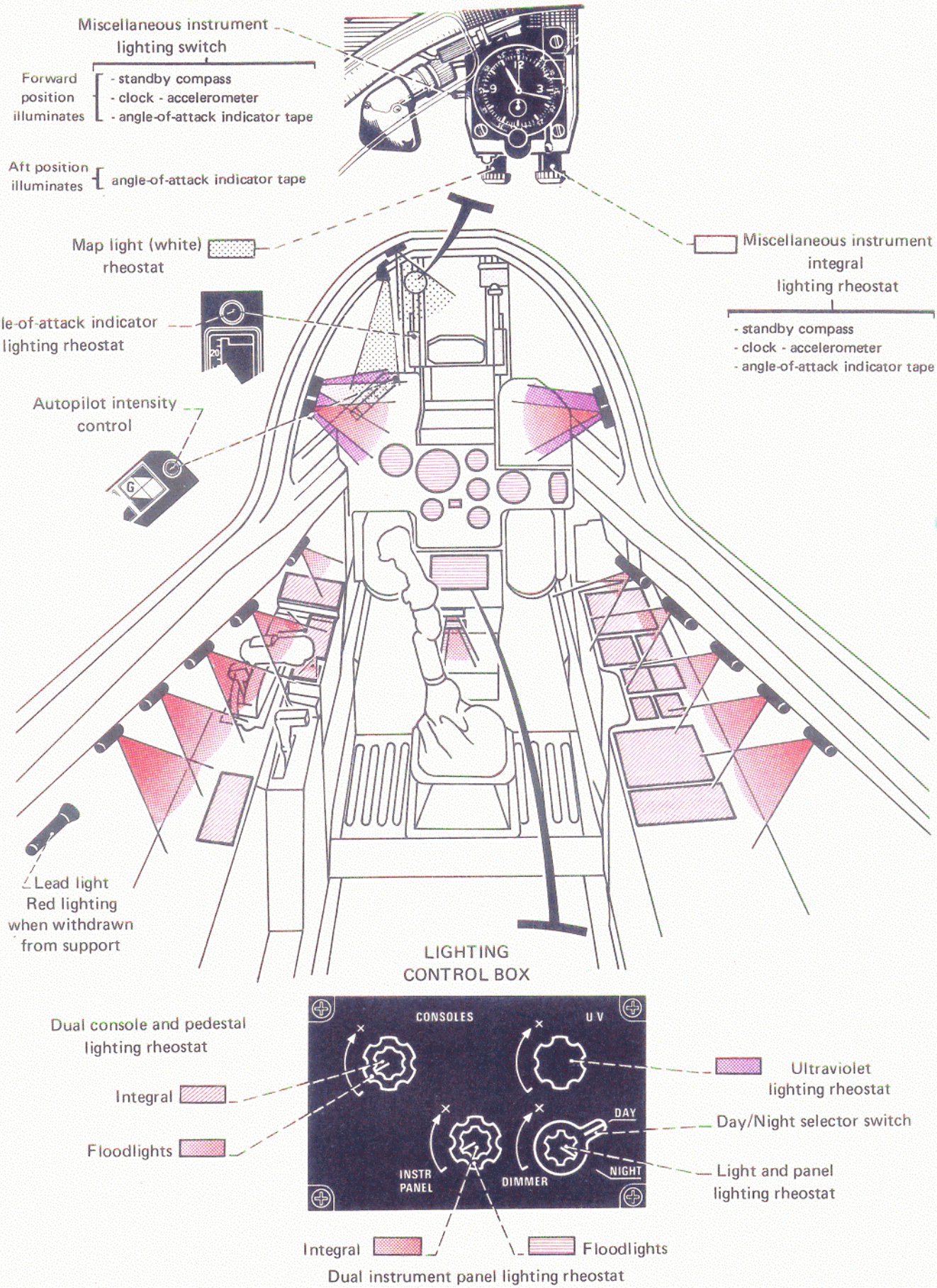


FIGURE 1 – COCKPIT LIGHTING

1,50.3 - CONTROL STICK GRIP

ITEM	NAME	DESCRIPTION	REMARKS
CONTROL STICK GRIP	Trim switch	5 positions	Stable at neutral
	Gun firing control	Button	Actuated by the firing trigger
	Sight camera control	Button	
	Bomb/Rocket/Missile/ Sight camera control	Button	Protected by the firing trigger when in inoperative position
	Microphone control	Button	
	Autopilot disconnect control	Trigger	
	Autopilot disengage control	Lever	
	V3 function control	Button	

Apart from the various buttons and controls, the control stick grip has a mechanical safety device, consisting of a slide, which enables the sight camera button to be used without the risk of depressing the gun button.

1,50.4 - JETTISON BUTTONS

Apart from the normal release controls on the control stick grip and the armament control panel, buttons permit jettison of the following stores :

ITEM	NAME	DESCRIPTION	REMARKS
JETTISON	Emergency jettison button	«EMERG» recessed under a striped folding guard	Emergency jettison of all external stores (except wing tip stores)
	MATRA 550 missile jettison button	«SW» «JETT» recessed under a folding guard	Jettison of wing tip stores only
	Selective jettison button	«JETTISON» recessed under a folding guard	- Associated with the jettison selector ; selective jettison of various stores (fuselage, wing stations 1 or 2) - And according to selection at the armament control panel for MATRA 530 missiles
	Jettison selector	3 positions «WING» (2) (1) «FUS»	«WING» (2) : jettison of station 2 stores. Position (1) : jettison of station 1 stores «FUS» : jettison of underfuselage stores

FIGURE 2 – COCKPIT LAYOUT

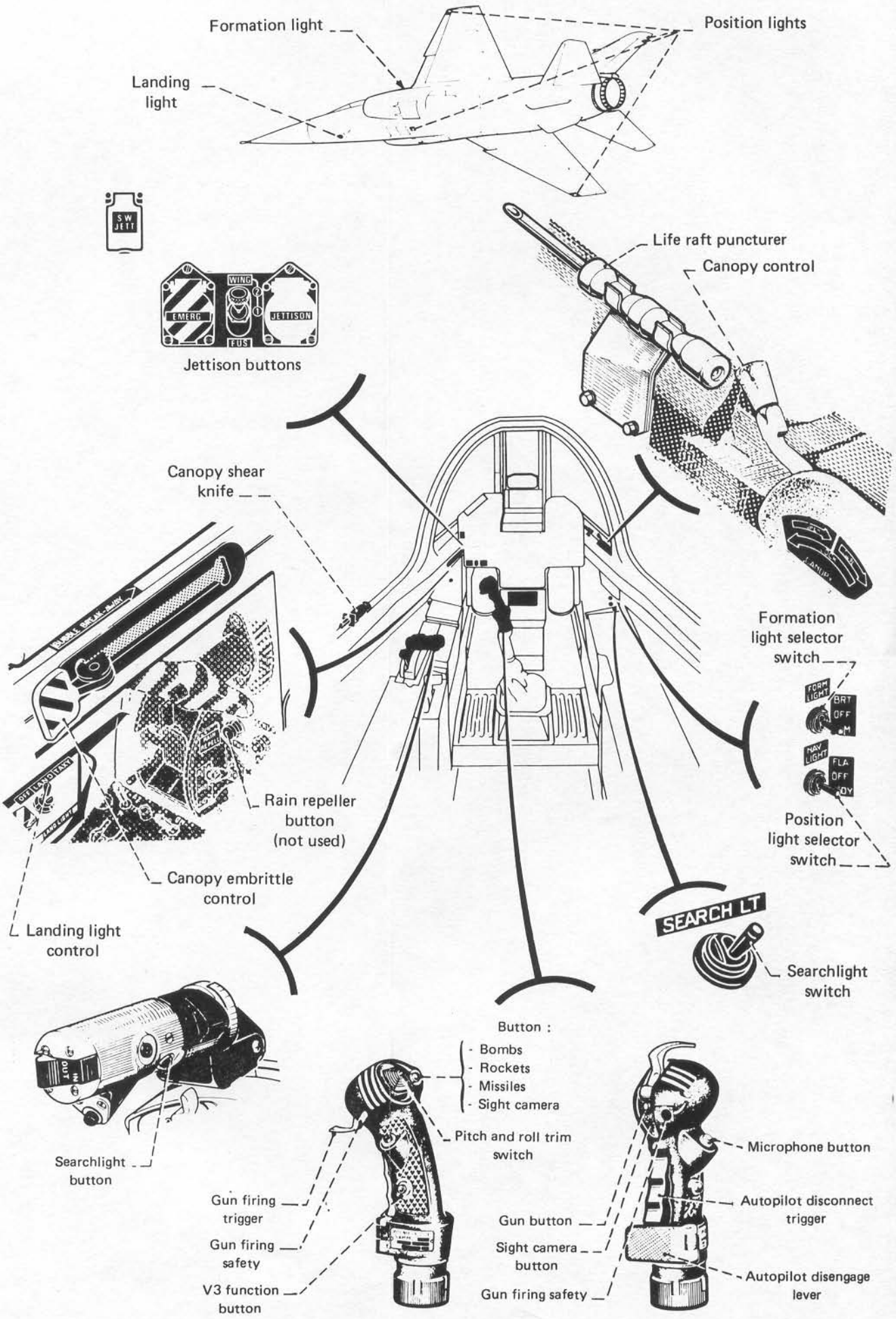


FIGURE 2 – COCKPIT LAYOUT

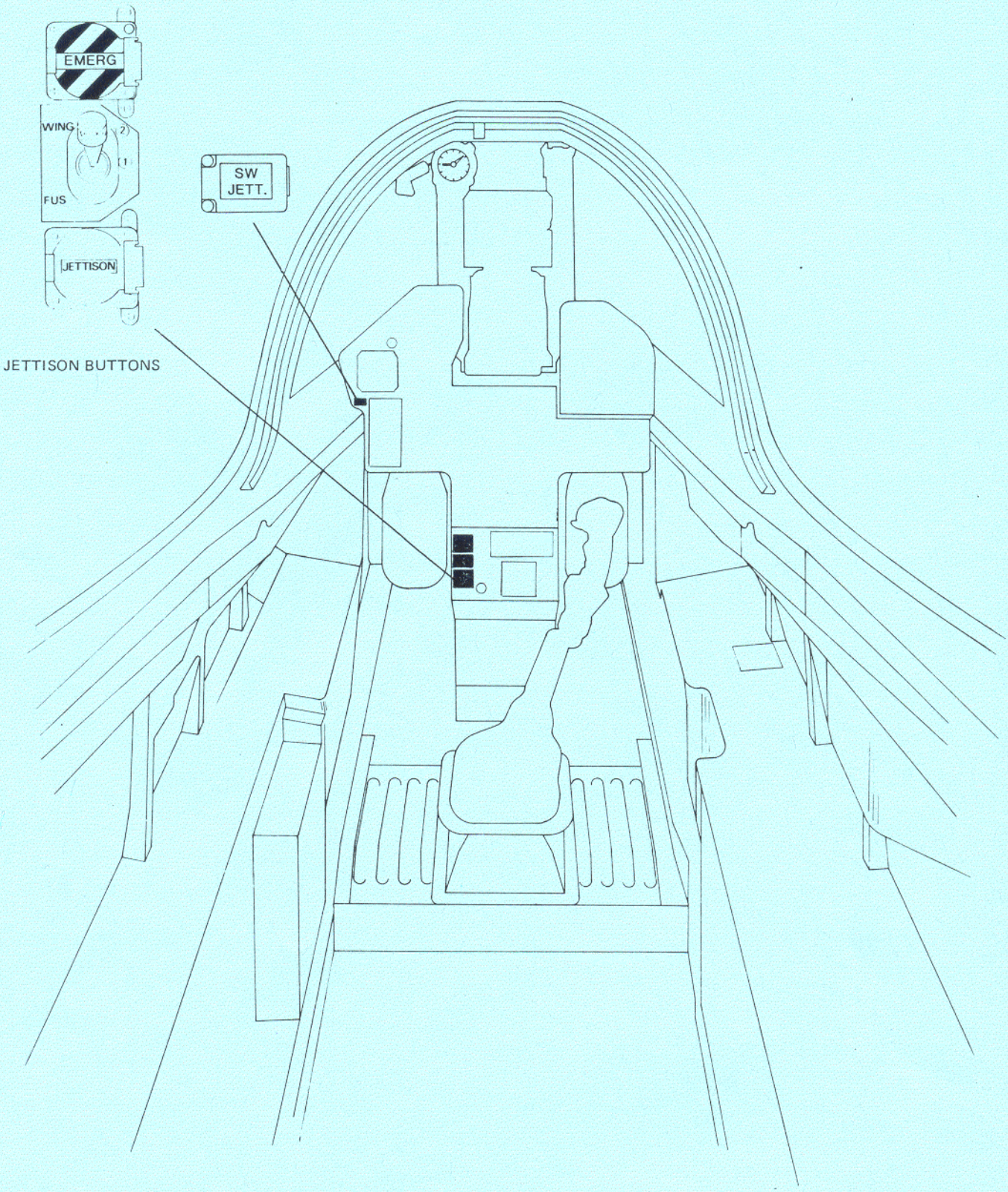


FIGURE 2A – COCKPIT LAYOUT
(POST/SAAF/MOD/MIR/282)

TP 0582

1,55 - PILOT'S EQUIPMENT AND ASSOCIATED SYSTEMS

1,55 - PILOT'S EQUIPMENT AND ASSOCIATED SYSTEMS

1,55.1 - EJECTION SEAT

1,55.1.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
HARNESS AND SEAT ADJUSTMENT	Quick-release box		
	Garters		Adjustable
	Shoulder strap locking lever	Three-position control lever	Spring-loaded central and aft positions
	Seat height adjustment control	Three-position selector switch	Unsteady up and down positions
EJECTION	Face blind firing handle	Double ring-shaped handle	
	Alternative firing handle	Single ring-shaped handle	
MANUAL CONTROLS	Separation handle	D-shaped handle	1st visible handle on LH harness strap
	Manual override lever	Two-position lever	Down : locking Up : unlocking
	Ripcord handle	D-shaped ring	2nd handle on LH harness strap, masked by a flap
MISCELLANEOUS CONTROLS	Personal equipment connector		See Oxygen Section
	IFF lanyard		
OXYGEN SUPPLY			See Oxygen Section

1,55.1.2 - DESCRIPTION

The aircraft is equipped with a MARTIN BAKER F1RM4A ejection seat provided with a face blind firing handle and an alternative firing handle.
The ejection envelope is given in SECTION 4, para. 4,55.1 : ESCAPE FROM AIRCRAFT IN FLIGHT.
When ejection is initiated, operation is fully automatic until the pilot reaches the ground (except for the survival pack separation which is manual).
The seat is a complete and independent assembly ; it includes all the components required for ejection.
It is installed on two guide rails and has a telescopic ejection gun attached to the aircraft structure. The explosive charge of the gun consists of a primary cartridge and two secondary cartridges which are successively fired.
Acceleration is gradual and may reach a maximum of 19 g's. The ejection velocity is about 24 m/s.

WARNING

THE EJECTION SYSTEM INCORPORATES EXPLOSIVE CARTRIDGES ; ACCIDENTAL FIRING OF ANY CARTRIDGE MAY CAUSE SERIOUS OR FATAL INJURIES ; THE SYSTEM IS PROVIDED WITH FIVE SAFETY PINS.

Chutes

A - Seat Drogue Assembly

This assembly includes a small controller drogue connected to a stabilizer drogue by a strap. The stabilizer drogue is connected to the seat by a shackle and scissors and to the pilot's parachute by a scissor shackle. At the end of its strap, the controller drogue is fitted with the drogue gun piston. The purpose of this assembly is to stabilize the trajectory and the movement of the seat, then to decelerate the seat to a speed allowing pilot's parachute opening.

B - Pilot's parachute

The pilot's parachute is stowed in a horseshoe pack at the pilot's shoulders level ; it includes a small controller drogue. A drogue shackle provides for separation of the pilot's parachute from the seat stabilizer drogue.

Combined harness

The combined harness is attached to the seat by three locks ; it includes :
- two sets of differently coloured straps (blue and green) used for pilot/seat and pilot/parachute strapping
- a negative-g strap (inverted flight or deceleration)
- a quick-release box used for fastening and locking of the two sets of straps.

CAUTION

WHEN THE QUICK-RELEASE BOX IS RELEASED, THE PILOT IS SEPARATED FROM BOTH THE SEAT AND THE PARACHUTE.

The L/H half-belt carries two D-rings one of which is masked :
- a manual override D-ring (visible) for separation from the stabilizer drogue
- a manual pilot's parachute opening D-ring (masked).

Survival pack

The survival pack is stowed in the seat pan ; it includes the following :
- a dinghy
- a main kit (including an emergency VHF radio beacon)
- a secondary kit.

It is connected to the combined harness by two quick-release fasteners and to the pilot by a lowering line (5-m (16-ft) long) used for quick opening of the pack and inflation of the dinghy.

NOTE : A dinghy puncturer is attached to the R/H glare-shield in the cockpit to puncture the dinghy in case of accidental inflation.

Calf-straps

The seat is provided with two calf-straps connected to the aircraft floor by adjustable straps and shear pins. Upon ejection, the straps are pulled to bring the pilot's legs against the seat and the shear pins break. A snubbing system holds the pilot's legs in this position ; they are released when the seat separates from the pilot.

Pilot's personal equipment connector

This connector is located on the L/H side of the seat ; it consists of a fixed part integral with the seat and a free part through which the pilot is connected to :
- the radio transmission and reception systems
- the main and emergency oxygen systems
- the anti-g suit supply system.

Upon ejection of the seat, the emergency oxygen cylinder attached to the seat supplies the pilot. The emergency oxygen supply is disconnected upon separation of the seat from the pilot.

IFF lanyard

This is a shear line which is attached on the R/H side of the seat to connect the latter to the distress switch. Upon ejection, it triggers the distress function of the IFF transponder.

Canopy breaker

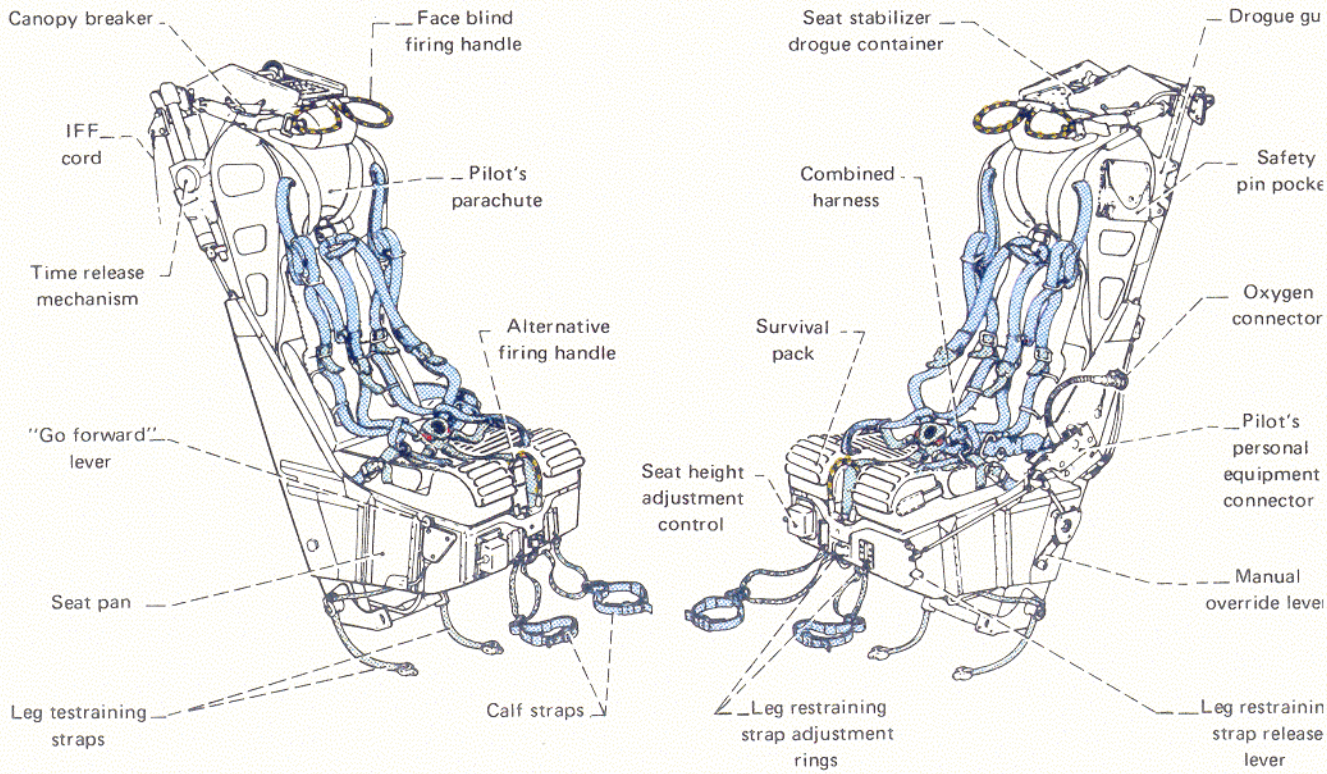
The canopy breaker consists of two blades installed on top of the seat. If canopy embrittlement fails upon initiation of seat ejection, the blades break the canopy to provide a passage for the seat.

Safety devices

To prevent accidental ejection when the aircraft is on the ground, five safety pins are fitted to the following :
- Face blind firing handle.
- Alternative firing handle.
- Ejection gun.
- Drogue gun.
- Embrittlement firing unit.

WARNING

THE SEAT SAFETY PINS MUST BE REMOVED ONLY AFTER PILOT STRAPPING ON THE SEAT.



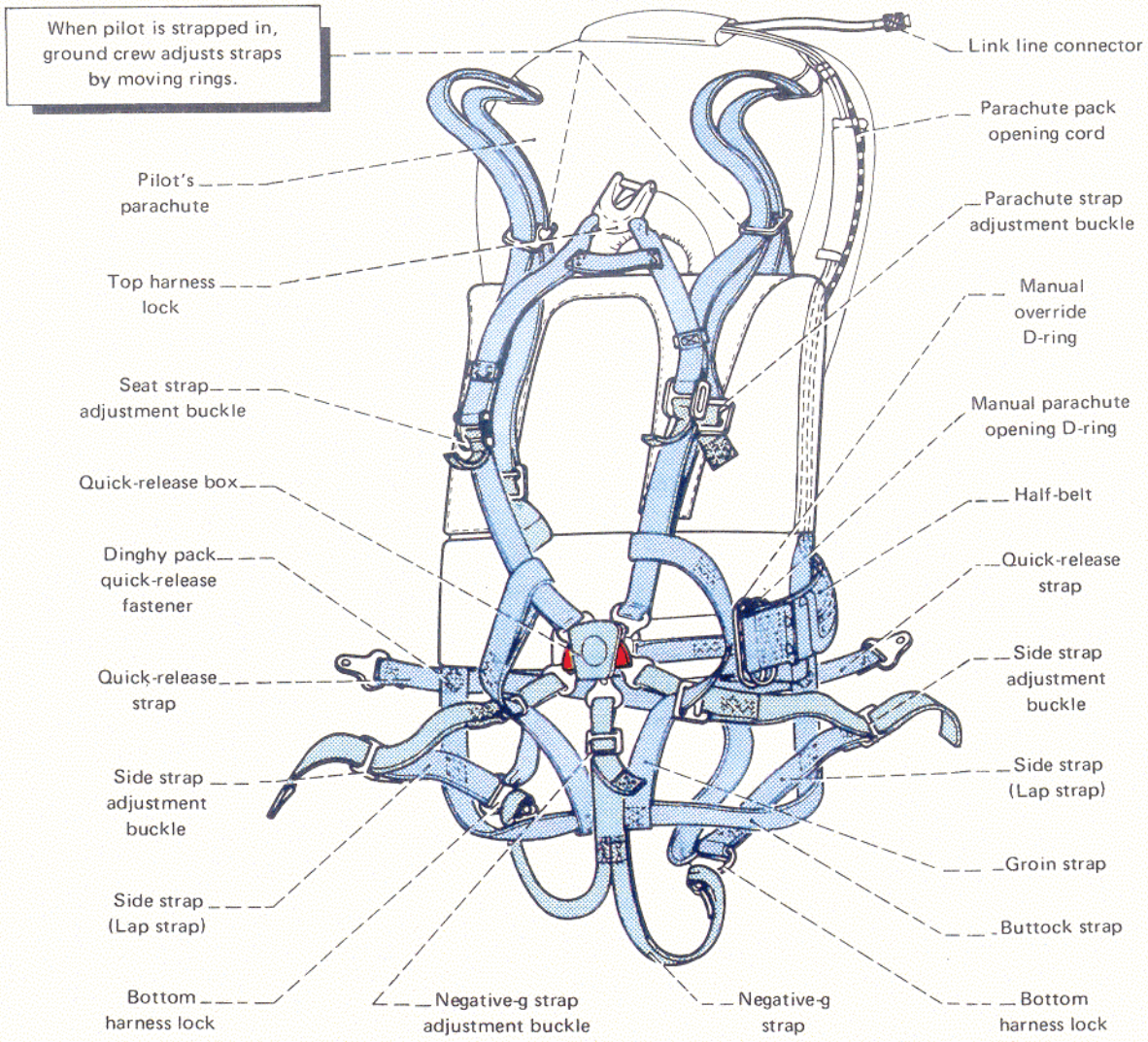


FIGURE 1 - EJECTION SEAT AND COMBINED HARNESS

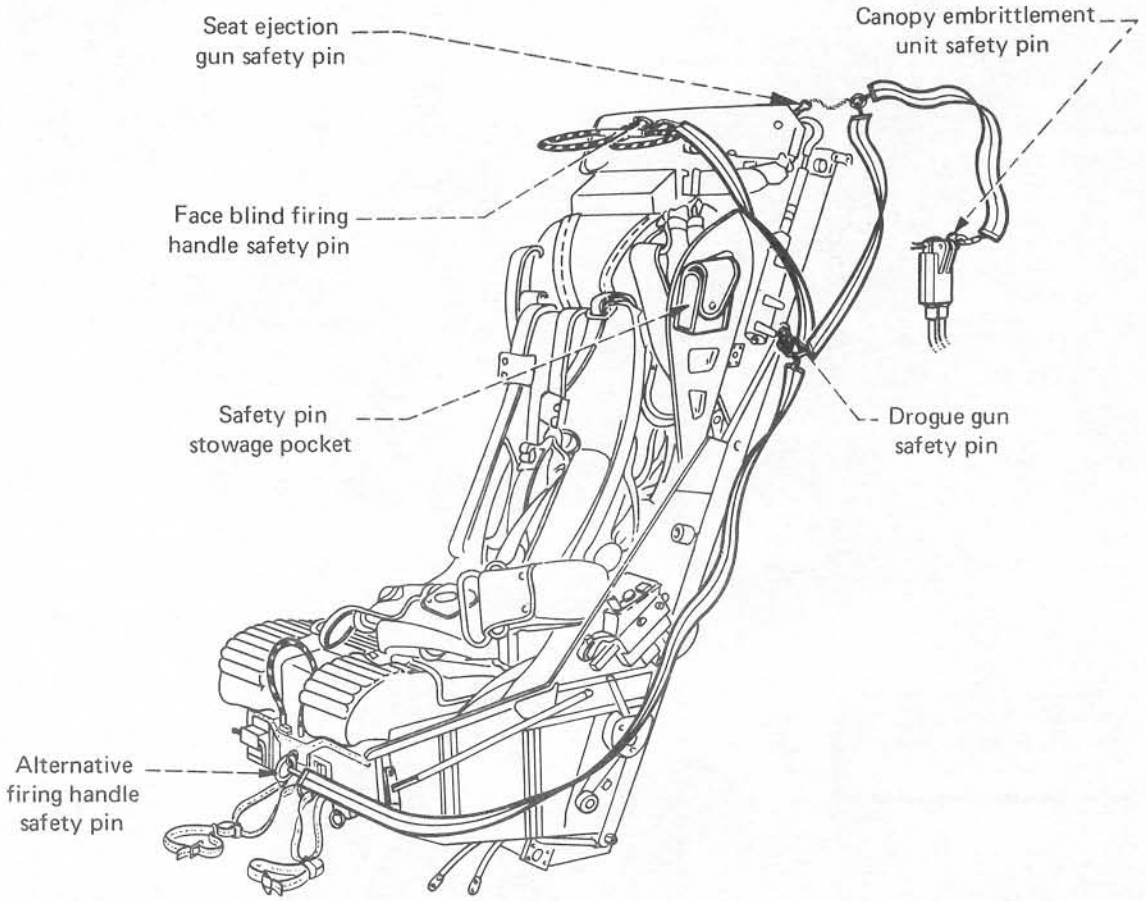

Seat ejection gun safety pin
Canopy embrittlement unit safety pin
Face blind firing handle safety pin
Safety pin stowage pocket
Drogue gun safety pin
Alternative firing handle safety pin

FIGURE 1H – EJECTION SEAT SAFETY PINS

Manual controls

A. Face blind firing handle

The face blind firing handle is the control that is normally used.

CAUTION

THIS CONTROL MUST BE FULLY PULLED ; ITS TRAVEL IS ABOUT 40 cm (16 in.) AND A FORCE OF ABOUT 20 daN (45 lbs) IS REQUIRED.

NOTE : The firing sear is extracted at the end of the pulling motion.
Using this control deploys the blind which protects the face.

B. Alternative firing handle

This control is to be used :

- When a precious time can be gained at the lower limits of the flight envelope.
- When the face blind firing handle cannot be reached (positive g's) or when the latter control is inoperative.

The pull force is about 25 daN (56 lbs) and the travel is about 10 cm (4 in.).

C. Seat height adjustment

The seat height is adjusted through an electric actuator controlled by means of a three-position (up-neutral-down) switch. This system is powered by the main DC system through the seat/aircraft quick-release coupling.

D - Shoulder strap locking/unlocking

This is accomplished by means of a lever on the R/H side of the seat pan.
- to unlock the shoulder straps, push the lever fully forward and let it return to the intermediate detent position. The shoulder straps are unlocked ; they are automatically locked between 2 and 3 g's.
- to lock the shoulder straps manually, release the lever from the intermediate detent position and pull it aft.

E - Leg restraining strap release

This is accomplished by means of a lever to be pulled aft to release the leg restraining straps (to be used on ground only when abondoning aircraft).

F - Personal equipment connector release handle

To release the junction assembly, lift the personal equipment connector handle while pressing the release button.

NOTE : This operation also releases the leg restraining straps.

WARNING

THE FOLLOWING THREE CONTROLS ARE USED IN EMERGENCY ONLY IN CASE OF FAILURE OF THE AUTOMATIC SEAT SYSTEM.

G - Manual override D-ring

This is the first one of the two D-rings on the L/H half-belt of the harness. Pulling this D-ring separates the pilot's parachute from the seat stabilizer drogue.

H - Manual override lever

This lever is used to separate the pilot from the seat but not from his parachute :
- when abandoning aircraft on ground in case of quick-release box jamming
- when seat ejection fails
- after ejection in case of failure of the automatic separation system.

When pulled up, this lever releases :
- the three locks attaching the harness to the seat
- the negative-g strap
- the leg restraining straps
- the free part of the personal equipment connector.

I - Manual parachute opening D-ring

This is the second one of the two D-rings on the L/H half-belt of the harness. Pulling this D-ring opens the pack containing the pilot's parachute and its controller drogue.
This D-ring is masked by a flap and can be reached only after the first D-ring has been pulled.

CAUTION

IT IS IMPERATIVE TO USE THE EMERGENCY CONTROLS IN THE FOLLOWING ORDER :
- PULL THE MANUAL OVERRIDE D-RING (RIGHT HAND).
- PULL THE MANUAL OVERRIDE LEVER (LEFT HAND).
- PULL THE MANUAL PARACHUTE OPENING D-RING (RIGHT HAND).

1,55.1.3 - NORMAL OPERATION

As soon as the face blind firing handle or the alternative firing handle has been pulled :
- The primary cartridge is fired.
- The gas pressure unlocks the seat and the initial travel of the latter embrittles the canopy.

The seat upward travel causes :
- Disconnection of the main oxygen supply and radio and electrical leads (disconnection of ejection seat/aircraft connector).
- Operation of the emergency oxygen cylinder.
- Switching of the IFF transponder to distress transmission.
- Triggering of the drogue gun time delay system and time release mechanism.
- Drawing of the pilot's legs against the seat.

NOTE : If the canopy embrittlement system fails, the breaker smashes the canopy to pieces to provide a passage for the seat.

As the seat moves up along its rails, the two secondary cartridges are fired. The drogue gun time delay mechanism is triggered. One second later, the drogue gun operates and its piston extracts the controller drogue of the seat. The controller drogue then deploys the stabilizer drogue. The seat is decelerated and stabilized.

The following sequences are dependent on the operation of two mechanisms :

- The inertia g-controller (adjusted to 4 g's) which prevents the pilot's parachute from opening as long as the speed of the seat is too high.
- The barostat which keeps the pilot strapped in his seat while descending rapidly from a cold and rarefied atmosphere to a more bearable altitude and allows deployement of the pilot's parachute at 15,000 feet.

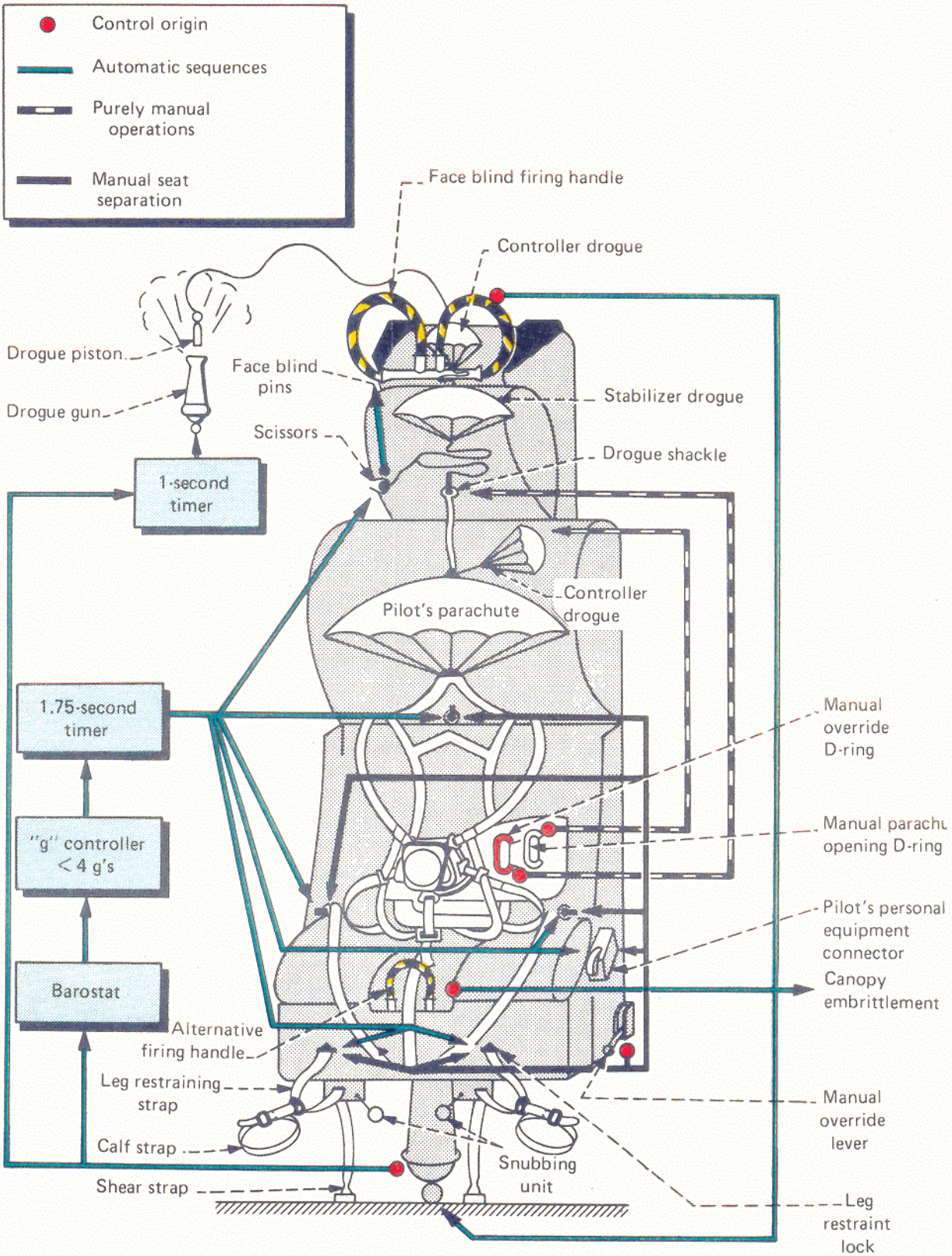
When both the altitude and deceleration requirements are met, the barostat operates the time release mechanism. After a 1.75 second time delay :

- The stabilizer drogue is separated from the seat.
- The face blind is freed ; the pilot must release it.
- If ejection has been initiated with the alternative firing handle, the pilot must release it as it is part of the seat.
- The stabilizer drogue, still connected to the pilot's parachute deploys the latter.
- The seat separates from the harness and the free part of the personal equipment connector is disconnected at the same time.
- The leg restraining straps and the negative-g strap are released.

In the most favourable cases (ejection at low altitude and moderate airspeed), the pilot's parachute is deployed 3 seconds after the firing control has been pulled.

When the parachute is open, the rate of descent is about 7 m/sec. (23 ft/sec.).

FIGURE 1R – EJECTION SEAT - OPERATION



For reasons of clarity, the leg restraining straps have not been crossed in this diagram ; they are shown directly routed.

FIGURE 1R - EJECTION SEAT - OPERATION

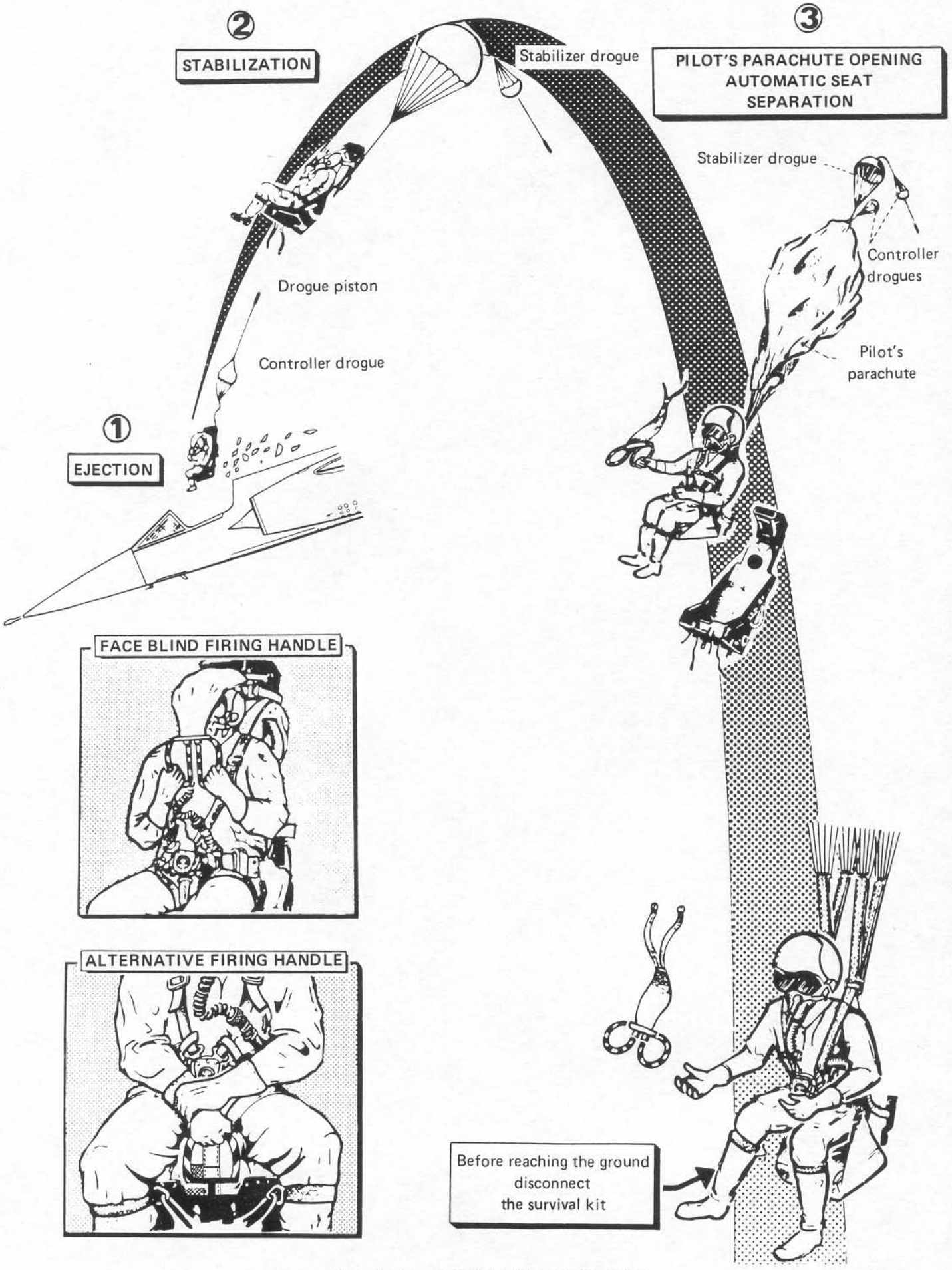


FIGURE 2 - EJECTION SEQUENCE

1, 55.2 - OXYGEN SYSTEM

1, 55.2.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
SUPPLY	Normal oxygen cock	2-position switch	Shut-off cock
	Emergency oxygen cock	2-position switch	Pressure reducing cock
	Mode selector switch	3 positions "N - 100 % - EMG"	With magnetic repeater
	Oxygen overpressure button	2 positions	With a foolproof device showing the position of the button
	Anti-g valve cock	2 positions	
	Anti-g test button	Spring-loaded	
INDICATORS	Oxygen indicator	Graduated arc Red - Green	
		Blinker Black - White	
		Magnetic repeater N - white - red	
		"T" button	
	"Ox. T" button		
	Ox REG light	Red	
	5mn Ox light	Amber	
	Circuit-breaker	"OX"	
	Oxygen quantity ground test button	"OXY. GND TEST" Spring-loaded	Gauge electrical power supply

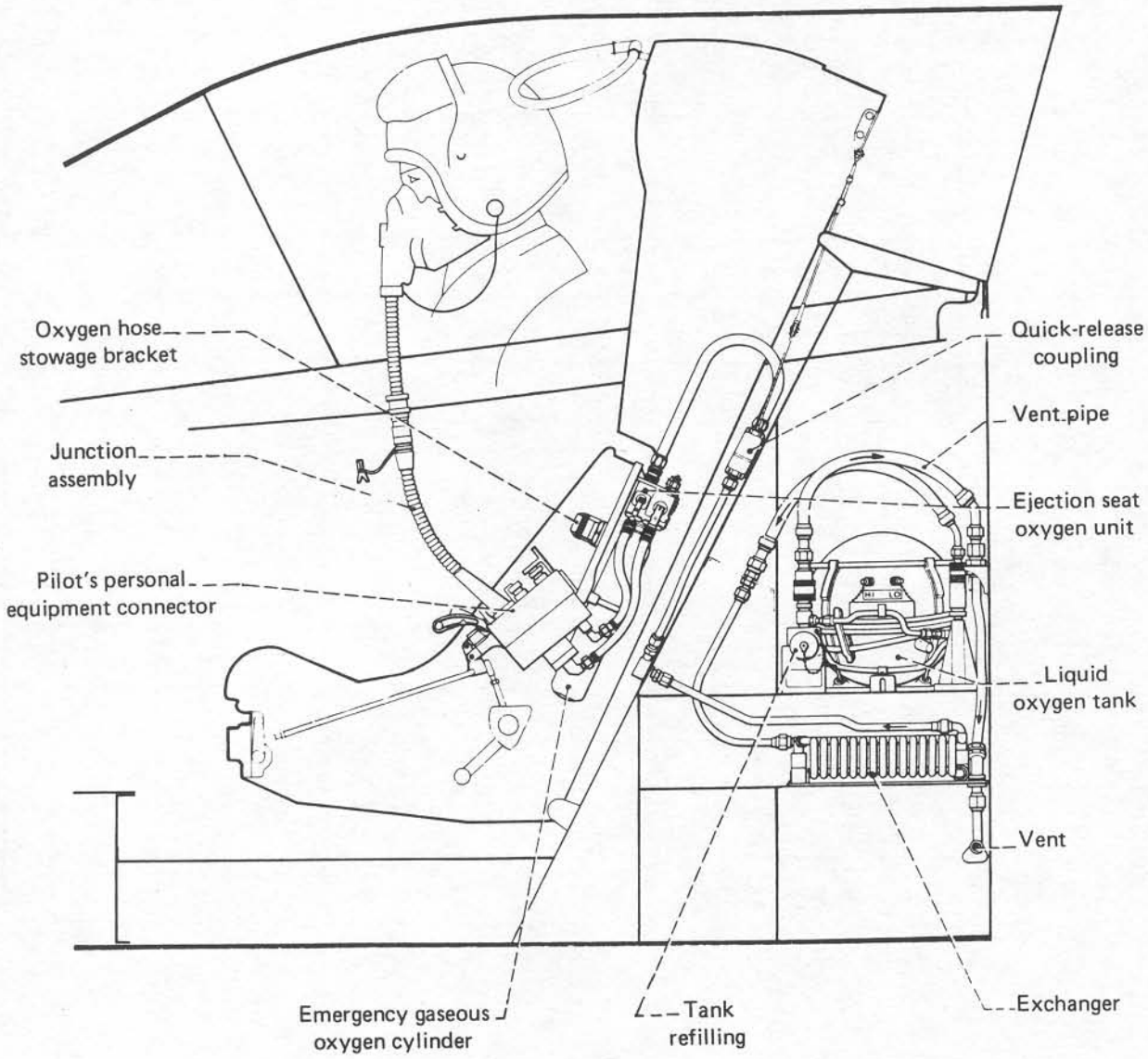


FIGURE 3 - OXYGEN SYSTEM LAYOUT

1,55.2.2 - DESCRIPTION

The oxygen system comprises :

- a 5-liter (305 cu.in) capacity liquid oxygen tank
- an exchanger and a distribution system
- a disconnect connecting the aircraft and seat systems
- an ejection seat oxygen unit
- an emergency gaseous oxygen cylinder having a capacity of 0.4 liter (24 cu.in) at 180 bar (2611 psi)
- a personal equipment connector (PEC) which connects the seat to the pilot's equipment and contains the regulator assembly and the anti-G valve
- an electrical system for the indicator and for failure detection, which is protected by the «OX» circuit breaker

1,55.2.3 - OPERATION

The system is normally supplied from the aircraft oxygen tank ; the liquid oxygen reaches, after transformation and regulation, the exchanger where it is brought to a breathable temperature.
The oxygen is then directed to the ejection seat oxygen unit, where it is distributed to the regulator and the anti-G valve. Finally, it is delivered to the pilot and to his anti-G suit. In case of failure of the normal oxygen supply, or of seat ejection, the emergency cylinder automatically supplies the pilot. In this case, the anti-G function is no longer performed.
The operating modes of the regulator are selected through a manually operated selector, the positions of which are shown by a magnetic indicator.

With aircraft oxygen tank used :

(1) Normal Operation

- Selector set to «N» : The magnetic indicator shows the letter N (normal).
  The regulator supplies, on demand, a mixture of air and oxygen which varies with the altitude.
  From approximately 33,000 ft, the regulator supplies pure oxygen.

- Selector set to «100%» : The magnetic indicator shows a white square.
  The regulator supplies, on demand, pure oxygen at all altitudes.

(2) Emergency Operation

- Selector set to «EMG» : The magnetic indicator shows a red square.
  The regulator supplies, with a continuous flow, a mixture of air and oxygen which varies with the altitude.

With emergency cylinder used :

In case of failure of the aircraft oxygen supply, or of seat ejection, the regulator switches automatically to emergency operation, irrespective of the position of the selector.

In both systems of supply :

- automatic positive pressure (in case of accidental cockpit decompression)
  Above approximately 36,000 ft (cockpit altitude), an increasing pressure is established in proportion to the altitude so as to protect the pilot against depressurization effects
- voluntary positive pressure
  When the positive oxygen pressure button is depressed, a positive pressure is established in the mask, irrespective of the altitude.

NOTE : With the selector at «N», the blinker «black» and the mask undone, a very slight continuous flow of oxygen may be perceived.

(3) Test operation

Oxygen warning test :

- Depress the "OX. T" oxygen test button on the failure warning panel.
- The **Ox REG** light comes on as well as the red master warning light.
- The "oxygen" warning horn sounds.
- Depress the master failure warning light : the light goes out.
- Release the oxygen test button : the **Ox REG** light goes out and the warning horn stops.

(4) Oxygen quantity check (ground power unit connected)

- Set the battery switch to "ON".
- Read the amount of oxygen remaining ; check for correct indication by depressing the "T" button on the oxygen indicator. The pointer continuously oscillates between the extreme full and empty positions and should stabilize in its initial position when the "T" button is released.
- If the pointer stabilizes outside the green range, have the tank replaced.

NOTE 1 : If the ground power unit is not connected, proceed as follows :
- Depress the "OXY. GND TEST" button.
- Keep the button depressed during the gauge test.

NOTE 2 : When the "OX" circuit-breaker is pulled out, oxygen regulation continues normally, but the amount of oxygen remaining and the position of the selector switch are no longer repeated on the indicator, and the blinker remains stationary ; in addition, the failure warning system is inoperative (no failure warning light or warning horn).

OXYGEN DURATION

The oxygen consumption varies considerably according to the pilot, type of flight, altitude and operating mode of the regulator.
The aircraft oxygen tank has a duration extending, in extreme cases, from 4 hours to 11 hours 30 minutes.
The emergency cylinder has a duration of 7 minutes in case of ejection, if this supply has not already been used.

1,55.2.4 - FAILURES

Ox REG light on + warning horn

- Selector switch set to "N" or "100 %" : when a regulator failure occurs, the flow detector sends a signal to the failure detector which delays the information for 22 seconds and then illuminates the light (pilot not breathing for a period longer than 22 seconds).

  The blinker shows a black square : no flow
  The blinker shows a white square : continuous flow

- Selector switch set to "EMG" : the **Ox REG** light should go out

  The blinker shows a white square ; the warning horn stops.

If the selector switch is set to "N" or "100 %", the **Ox REG** light will come back on after 22 seconds. In this case, automatic switch over from the aircraft supply to the emergency supply does not take place sharply ; the "demand" function is maintained for a while because of the system residual pressure, which causes the flow to be erratic. When the "EMG" position has been selected, the pilot should therefore avoid to reselect the "N" or "100 %" position.

5mn Ox light on

This light comes on when :

- the emergency oxygen cock is not open
- the pressure in the emergency system is $<$ 150 bar (2176 psi).

In the latter case, only a maximum of 6 minutes of oxygen is left when the light comes on.

FIGURE 3M – OXYGEN SYSTEM CONTROLS AND INDICATORS

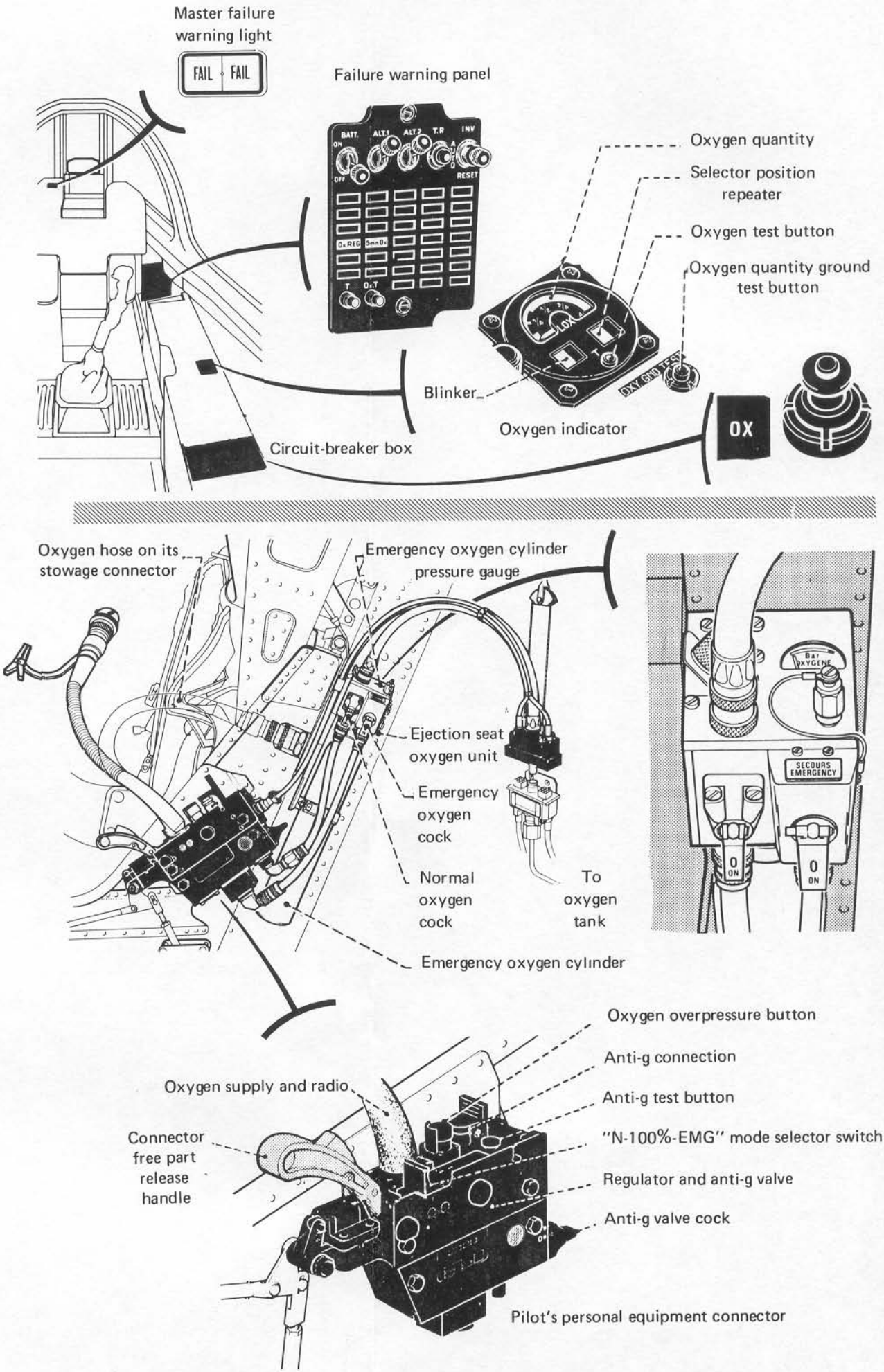


FIGURE 3M - OXYGEN SYSTEM CONTROLS AND INDICATORS

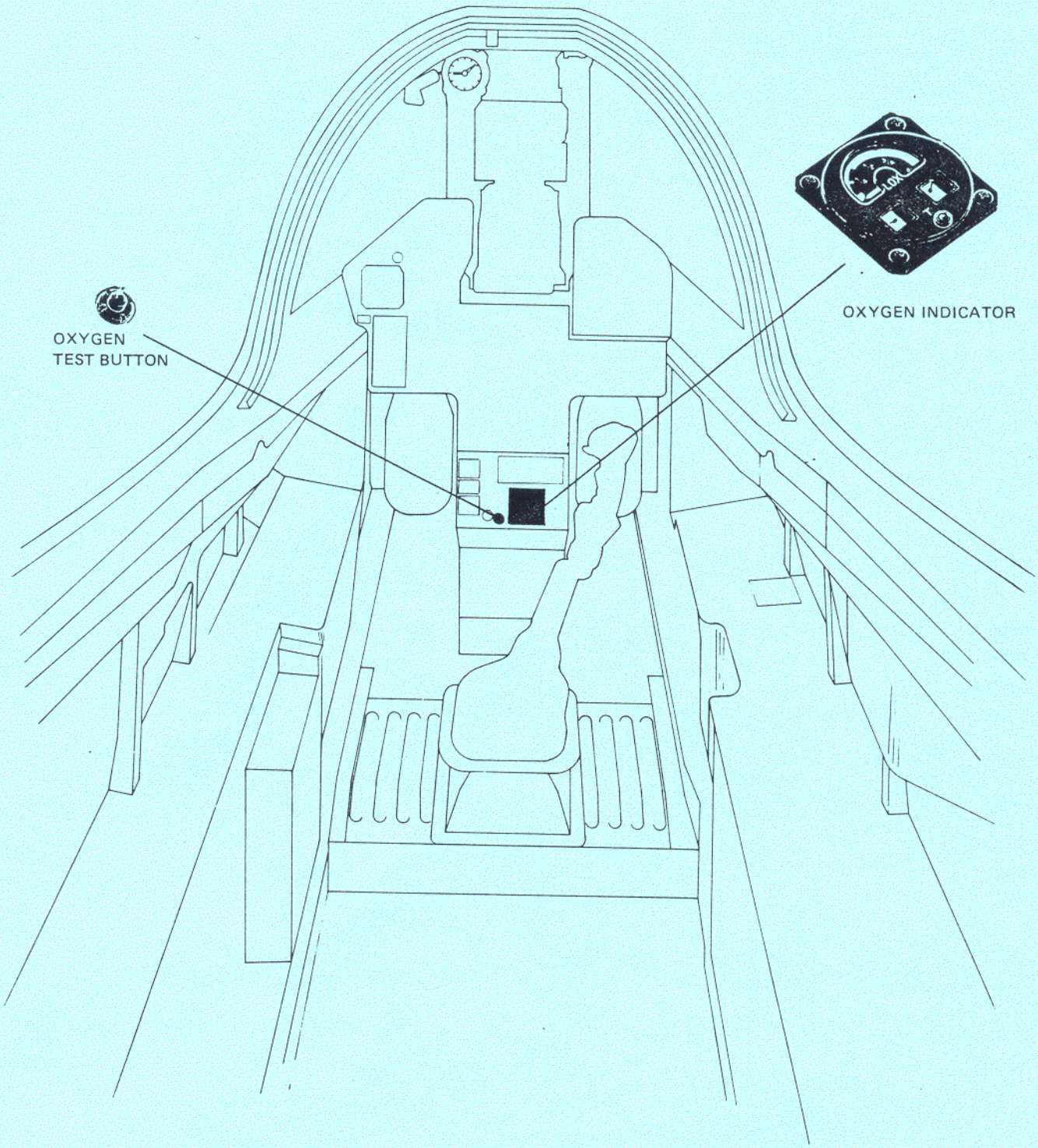


FIGURE 3MA – OXYGEN SYSTEM CONTROLS AND INDICATORS
(POST/SAAF/MOD/MIR/282)

1,55.3 - AIR CONDITIONING SYSTEM

1,55.3.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
CABIN SEALING	Canopy control	Lever with 2 quadrants 3 positions	Locking Opening - Closing
	Canopy seal valve control lever	2 positions "DEFLATE" "INFLATE"	
CABIN AIR CONDITIONING AND PRESSURIZATION	Master valve control switch	2 positions Locked on "ON"	Controls cabin and equipment bay air conditioning
	Temperature control rheostat	Rotary selector switch 2 sectors "AUTO - MANUAL"	
	Cabin solenoid valve position indicator	2 sectors	
	Emergency cold switch	2 positions	
	CAB.T light	Red	
	CAB.P light	Red	
	Circuit-breaker	"CAB P"	
	Circuit-breaker	"CAB T"	
	Cabin altimeter		Graduated from 0 to 40,000 ft
DEMISTING	Demist switch	2 positions	
RAM AIR	Ram air switch	2 positions Guarded	
EQUIPMENT AIR CONDITIONING	Automatic/Manual selector switch	2 positions "AUTO" "MANUAL"	
	Hot/Cold control switch	2 unstable "HOT" "COLD" positions and spring-loaded neutral position	
	Temperature indicator		
	EQ.T light	Amber	

1,55.3.2 - DESCRIPTION

Cabin air conditioning and pressurization, and equipment air conditioning, are ensured by air bled from the last compressor stage of the engine.

The hot air is circulated first through a precooler which lowers its temperature.

At the outlet of the precooler, a branch pipe supplies the following systems :

- windshield demisting
- radar pressurization
- canopy seal inflation .

The system then comprises :

- a master valve which allows the system to be isolated in case of failure
- a cooling assembly composed of two parallel lines :
  - a direct line, in which the flow of hot air is controlled by a solenoid valve for the cabin system and a solenoid valve for the equipment system. These variable opening solenoid valves, which are slaved to their own temperature regulators, by-pass more or less of the hot air to the other line
  - an indirect line (cooling loop), constituted by the following components connected in series :
    - a primary air cooler
    - the compressor stage of the cold air unit
    - a main air cooler
    - a water evaporator
    - the expansion turbine stage of the cold air unit.

    This loop is passive : it provides cooling only when air is flowing through it.
    The expansion turbine, the last component of the loop, drives the compressor which circulates the air in the main air cooler (thus closing the loop).
    Between the two is fitted a water evaporator which operates on a purely physical principle requiring no external energy. As soon as the temperature of the air to be cooled rises appreciably, the water boils and becomes vapour thus absorbing calories.

In order to provide a correct conditioning air temperature when the aircraft is on the ground with the engine running (taxiing or take-off), the efficiency of the coolers is increased by producing an air flow with a GIFFARD type ejector (venturi effect).
A cock, electrically controlled upon retraction of the L/H U/C leg, closes this by-pass after take-off.

At the expansion turbine outlet, the air flow is separated into two branches : one supplying the cabin system and the other the equipment system.
In each branch, the hot air from the direct line and the cold air from the cooling loop are mixed together and flow :

- cabin system : through a water separator before being distributed into the cabin
- equipment system : into an air/liquid exchanger for cooling the radar and then ventilating the head of the MATRA missile and the equipment in the equipment bay and MTI (Moving Target Indicator) bay.

A ram air inlet in the nose cone of the aircraft (L/H side) ensures cabin ventilation with fresh air in case of malfunction of the air conditioning system. The air inlet is controlled by a solenoid valve actuated by a switch available to the pilot.

1, 55.3.3 - OPERATION

1 - CABIN AIR CONDITIONING

The basic regulating device is the solenoid valve which, according to its position, admits more or less hot air into the hot air/cold air mixture, thus regulating the cabin temperature.
The solenoid valve operates, as desired, automatically or manually.

Automatic operation :

When the temperature control rheostat is positioned with the index in the front sector, the solenoid valve operates automatically. An amplifier, fed with information from a cabin sensor and a duct sensor, controls the solenoid valve so as to maintain a temperature in the cabin as close as possible to that set on the rheostat.

NOTE : When the U/C is extended, the cabin temperature is regulated by the duct sensor by anticipation.

Manual operation :

If the temperature control rheostat is turned through 180° (index pointing backward), the amplifier is practically by-passed and operation of the solenoid valve becomes manual. Due to a spring action, the temperature control rheostat is swung back to the 6 o'clock position ; by giving short impulses on the "HOT" or "COLD" side, the position of the solenoid valve is changed until the desired temperature is obtained.

The automatic operating mode is normally used ; the manual operating mode is used only in case of failure of the automatic system.
If the air conditioning system becomes jammed in the "full hot" position and if manual actuation of the temperature control rheostat is ineffective, by moving the "EMG COLD" switch to the left a closing signal is fed to the regulating solenoid valve.

2 - CABIN DEMISTING

- When the demist switch is set to the forward position, the demisting valve opens and allows a direct flow of hot air onto the front and L/H windshield panels.
- When the ram air switch is switched on, outside air is directed onto the panels.

3 - CABIN SEAL INFLATION

To inflate the seal, the canopy must be closed and locked and the canopy seal valve control lever in the forward position.
The canopy seal is deflated merely by unlocking the canopy.

4 - CABIN PRESSURIZATION

With the master valve control switch set to "ON", the canopy seal inflated and the ram air inlet closed, the cabin is pressurized through automatic conditioning air discharge control.

A pressure regulator allows part of this air to escape into the equipment bay in order to maintain in the cabin a pressure responding to the following schedule :

- from 0 to 6500 ft : cabin pressure equal to outside pressure
- from 6500 to 18, 000 ft : cabin pressure constant and equal to 6500 ft altitude pressure
- above 18, 000 ft : cabin pressure higher than outside pressure by 300 mb (4.35 psi).

REMARK : The cabin altitude does not exceed 30, 000 ft, even at aircraft ceiling.

5 - EQUIPMENT AIR CONDITIONING

The basic regulating device, as for the cabin, is the solenoid valve.
The temperature regulation is automatic when the switch is set to "AUTO".
When the switch is set to "MANUAL", the solenoid valve is controlled by impulses on the "HOT/COLD" control switch.

1, 55. 3. 4 - FAILURES

CAB.P light on + warning horn

The cabin altitude exceeds 30, 000 ft.
The canopy control is not in the correct position.

CAB.T light on + warning horn

The air reaches the cabin at a temperature > 60°C (duct sensor) and the cabin temperature exceeds 32°C (cabin sensor).

EQ.T light on

This light comes on when the temperature of the air flowing into the equipment bay is lower than 5°C or higher than 50°C.

REMARK : On the ground, when the temperature is either very high or very low, the EQ.T light may come on. It should go out after take-off. Leave the switch on "AUTO".

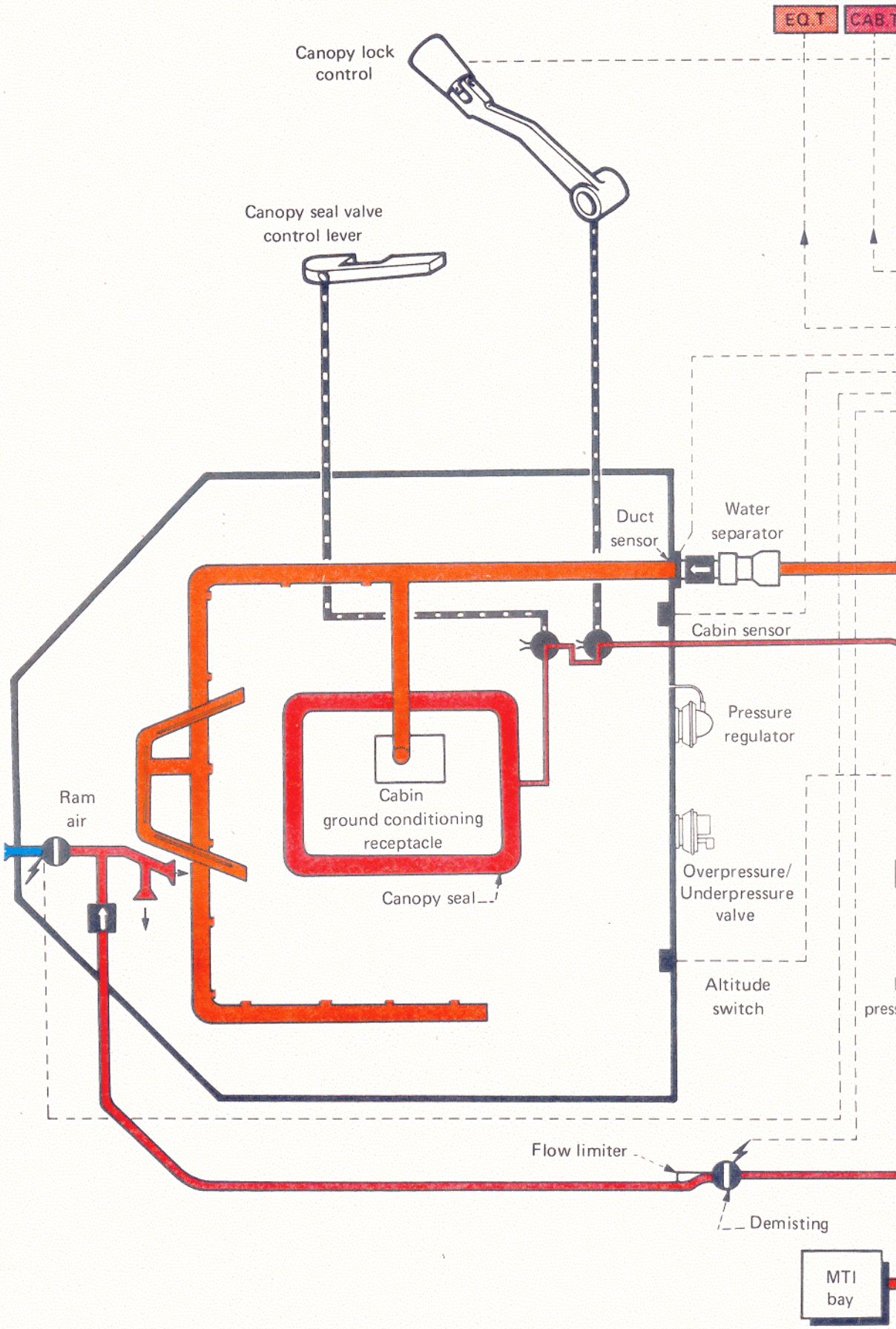


FIGURE 4 - AIR CONDITIONING SYSTEM

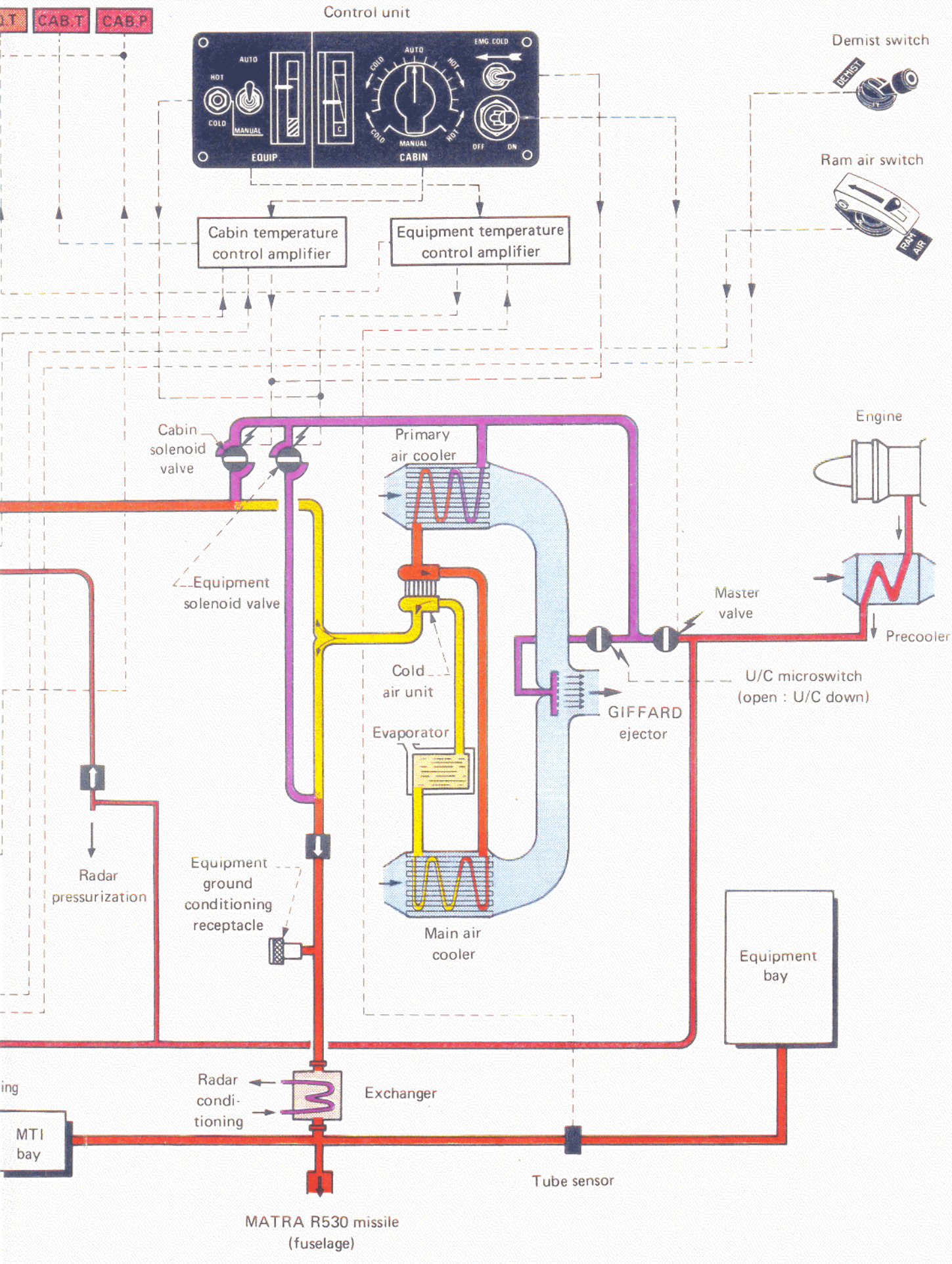

T
CAB.T
CAB.P
Control unit
AUTO
HOT
COLD
MANUAL
EQUIP.
AUTO
COLD
HOT
COLD
MANUAL
HOT
CABIN
EMG. COLD
OFF
ON
Demist switch
DEMIST
Ram air switch
RAM AIR
Cabin temperature control amplifier
Equipment temperature control amplifier
Cabin solenoid valve
Primary air cooler
Engine
Equipment solenoid valve
Master valve
Precooler
Cold air unit
U/C microswitch (open : U/C down)
GIFFARD ejector
Evaporator
Radar pressurization
Equipment ground conditioning receptacle
Main air cooler
Equipment bay
ing
Radar condi-tioning
Exchanger
MTI bay
Tube sensor
MATRA R530 missile (fuselage)

FIGURE 5 – AIR CONDITIONING SYSTEM CONTROLS AND INDICATORS

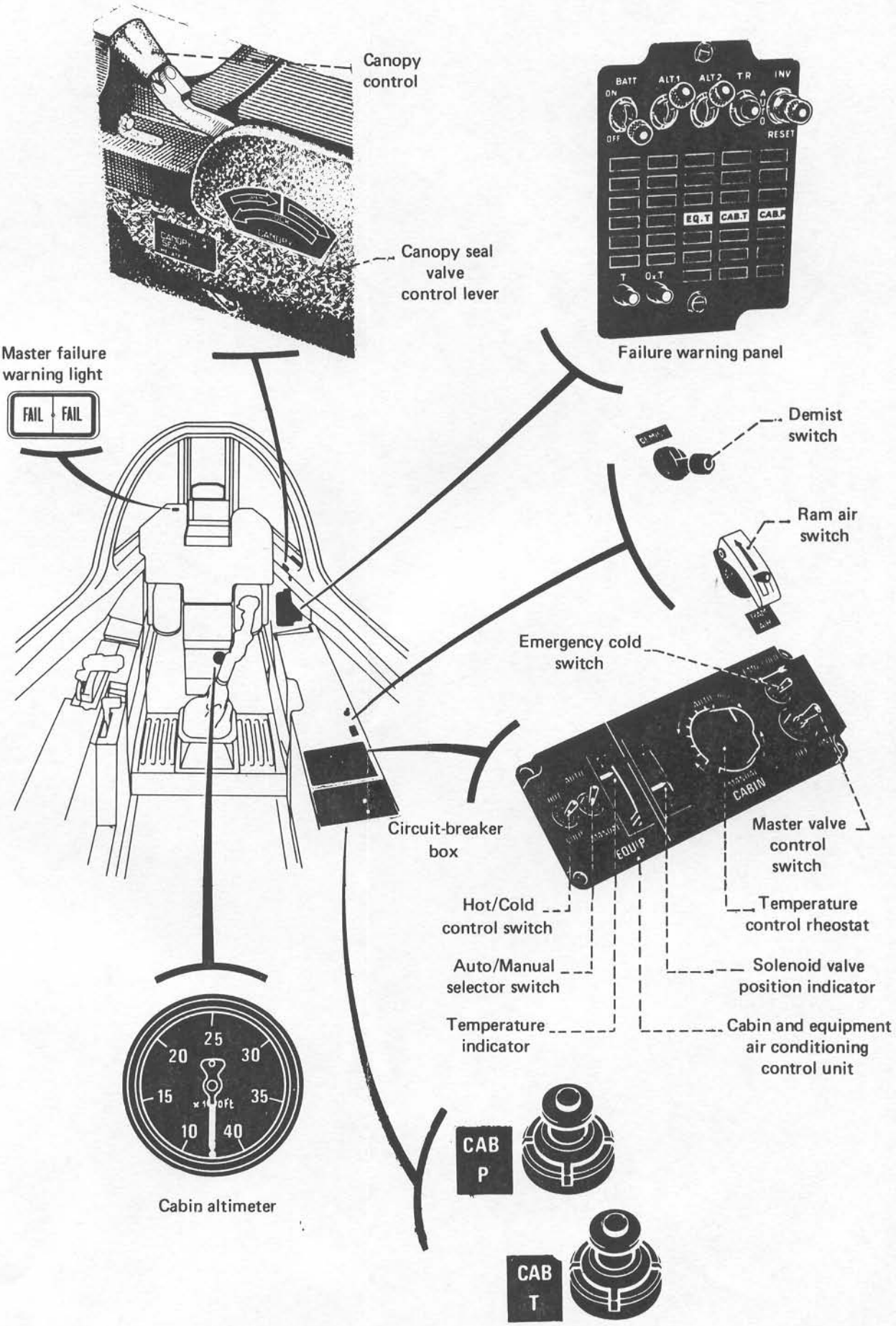


FIGURE 5 - AIR CONDITIONING SYSTEM CONTROLS AND INDICATORS

1,60 — WARNING SYSTEMS

The various warning systems, and the conditions under which the various indicator lights are illuminated, are dealt with under their related aircraft systems.
Certain of them are grouped on a single panel (configuration indicator, failure warning panel).
Figure 1 groups the various systems.

1,60.1 - FAILURE INDICATION

Failures are indicated to the pilot in three ways :

- by a failure warning panel (red and amber windows)
- by a master failure warning light (dual : red and amber)
- by a warning horn (with four different sounds).

1 - FAILURE WARNING PANEL

- the red lights : call for immediate action
- the amber lights : allow delayed action.

When a failure occurs, the detection system closes a circuit which causes :

- illumination of the red or amber lights
- illumination of the master failure warning light
- operation of the warning horn, when a red light is concerned.

2 - MASTER FAILURE WARNING LIGHT

By simply depressing the master failure warning light, the pilot can :

- extinguish this light
- stop the warning horn (except for the 0x REG warning which lasts as long as the failure persists)
- reset the warning assembly to indicate another failure.

The light on the failure warning panel remains illuminated as long as the failure persists.

3 - WARNING HORN

Particularly important failures and limitations are backed up by a warning horn having :

- a sound for the red windows of the failure warning panel (except 0x REG) and the A/B and engine fire warning lights
- a sound for the 0x REG window of the failure warning panel
- a sound for the limit incidence
- a sound for the "LIM" light.

Energization is achieved by means of the warning horn switch.

1,60.2 - "LIM" LIGHT

The illumination of this light, accompanied by a particular audio signal, indicates to the pilot that the following permissible limits are exceeded :

Full flap deflection	IAS > 225 kt	(Microswitch on L/H flap)
1/2 flap deflection through slat/flap lever	IAS > 300 kt	(Microswitch on L/H flap)
1/2 flap deflection in combat	IAS > 335 kt or M > 0.85	(Microswitch on R/H flap)
Slats extended	IAS > 470 kt or M > 1.10	(Microswitch on L/H slotted slat and L/H droop slat)
U/C down	IAS > 240 kt	(Nose U/C not uplocked, or nose U/C door not locked in closed position)
Total temperature 135°C	Mach = 2.10 in standard atmosphere above 36,000 ft	
Engine overspeed	RPM ⩾ 9200 or 109.5 %	

REMARK : The values indicated apply for increasing IAS. For decreasing IAS, the values read will be lower by approximately 20 kt.

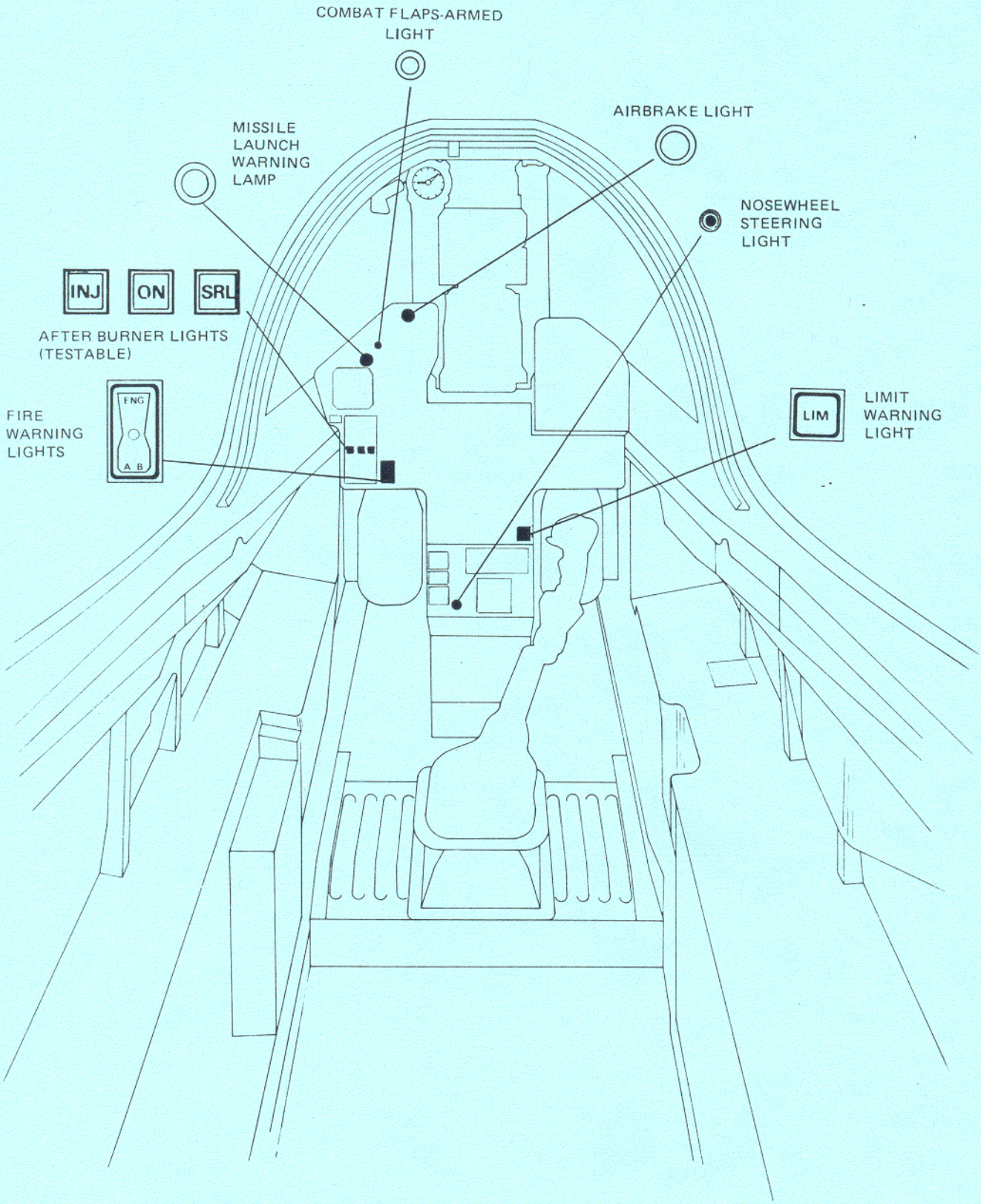


FIGURE 1A – WARNING LIGHTS AND INDICATORS
(POST/SAAF/MOD/MIR/282)

TP 0590

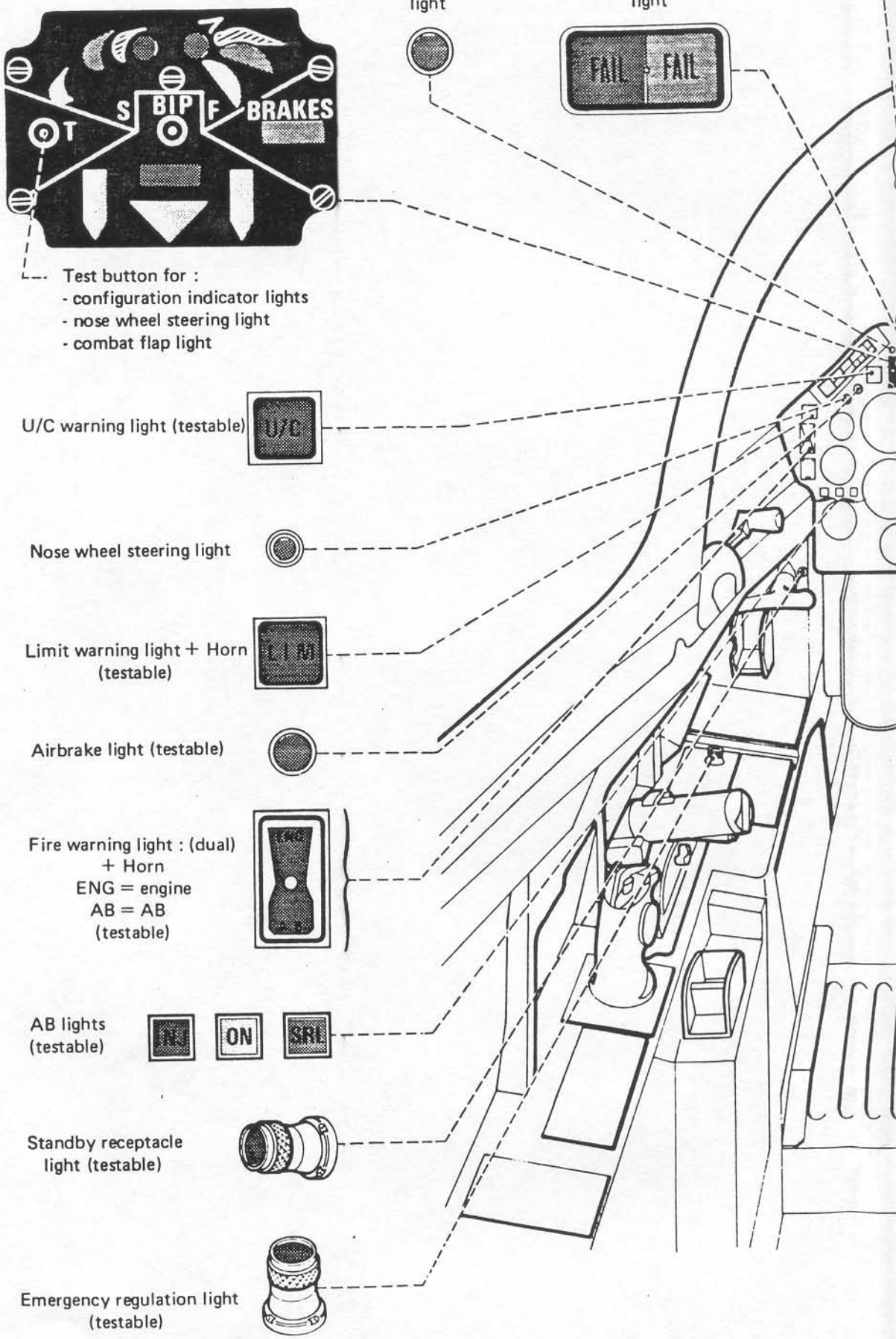
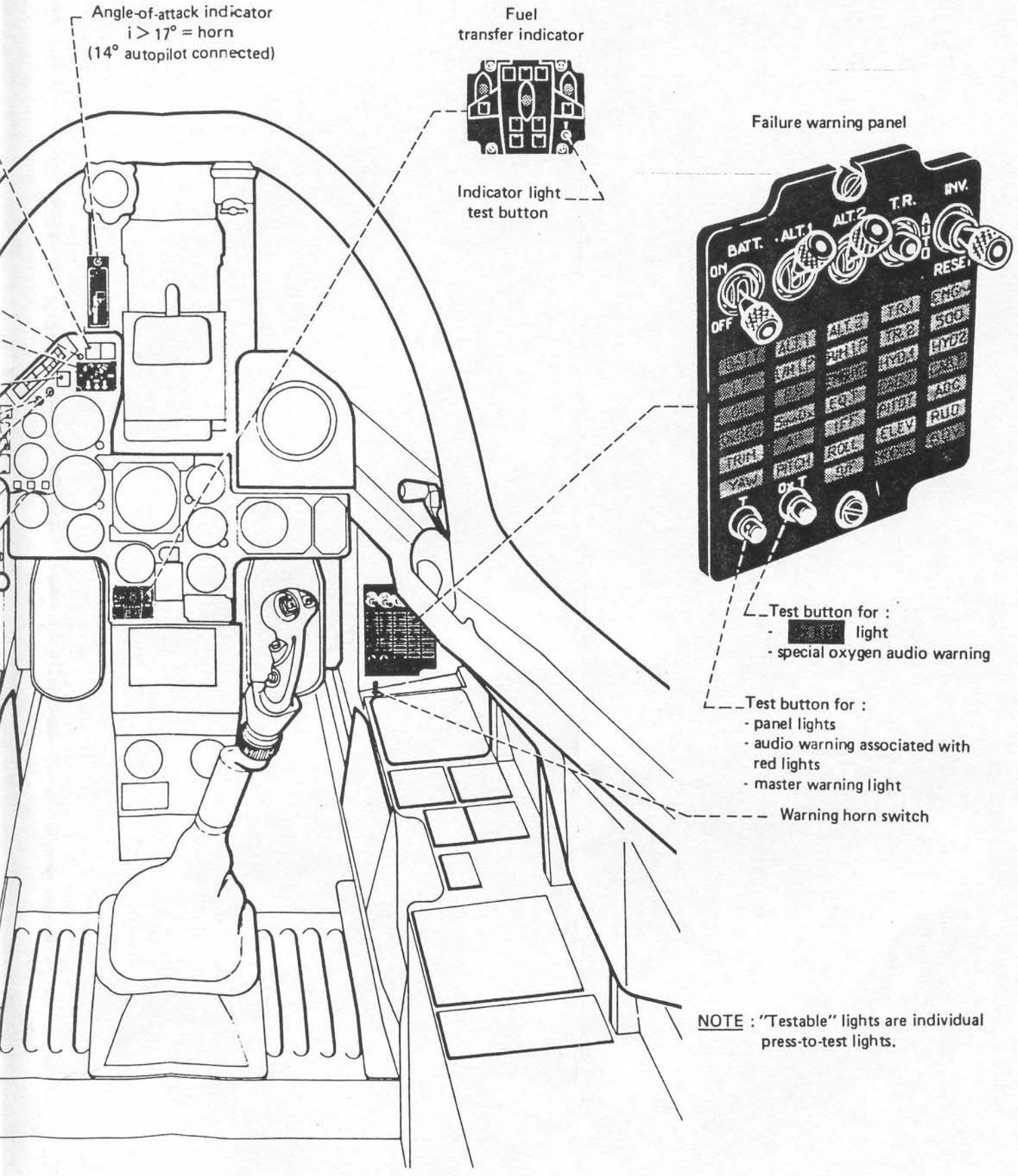


FIGURE 1 – WARNING LIGHTS AND INDICATORS



NOTE : "Testable" lights are individual press-to-test lights.

1,65 – RADIO SYSTEM

1,65 - RADIO SYSTEM

WARNING

This paragraph gives only a brief description of the radio system. It is dealt with in greater detail in Book 2.

1,65.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
MAIN (GREEN) V/UHF CONTROL BOX	Channel selector	Selection of a preset VHF or UHF frequency channel	31 channels
	Frequency selector switch	M : communications on manually selected frequency P : communications on preset channel frequency	
	Function selector	OFF : set off A3 : transmission/reception over main set A3 + G : transmission/reception over main set ; reception over guard set DF : not used	if UHF frequency is selected
	Frequency select thumbwheels	Manual selection of frequencies	- VHF (116 to 149.975 MHz) - UHF (225 to 399.975 MHz)
	"SQL" switch	Switches the squelch on or off	
	Test selector switch	- at "T + A2" : transmitter test - at "R" : receiver test	
	Test light	- transmitter/receiver check	
SECONDARY (RED) V/UHF CONTROL BOX	Channel selector	Selection of a preset frequency channel (V/UHF or UHF)	31 channels (225 to 399.975 MHz)
	Test selector switch	- at "T + A2" : transmitter test - at "R" : receiver test	
	Test light	- transmitter/receiver check	
	Function selector	OFF : A3 : Same as for green set A3 + G :	
	"SQL" switch	Switches the squelch on or off	

ITEM	NAME	DESCRIPTION	REMARKS	
RADIO SELECTOR UNIT	Potentiometers { MISS, TAC, VOR }	Adjust reception level by rotation		Warning horn audible in all positions
	"AMPLI 2-1" selector switch	Selects the two reception mixing amplifiers	See NOTE	
	Pushbuttons { Red, Green }	- Adjust reception level by rotation - Transmission over selected set(s) by depressing pushbutton(s)	BIP audible on all "transmission" positions	
	TB + MKR pushbutton	- Telebriefing communications by depressing pushbutton - Adjusts reception level by rotation	In flight : marker beacon reception	
	TB + MKR light	- External telebriefing system plug connected	Automatically disconnected when starting rolling	
PUSH-TO-TALK BUTTON	Control stick push-to-talk button		When telebriefing system is used, push-to-talk button is not used	
PROTECTION	V/UHF circuit-breaker			

NOTE : When the standby receptacle is connected, amplifier 2 must be selected to obtain receptions.

CAUTION

AMPLIFIER 2 IS POWERED BY BATTERY SYSTEM.
BEFORE LEAVING AIRCRAFT, SELECT "AMPLI 1" EVEN THOUGH "BATT" SWITCH IS "OFF".

FIGURE 1 – RADIO SYSTEM CONTROLS AND INDICATORS

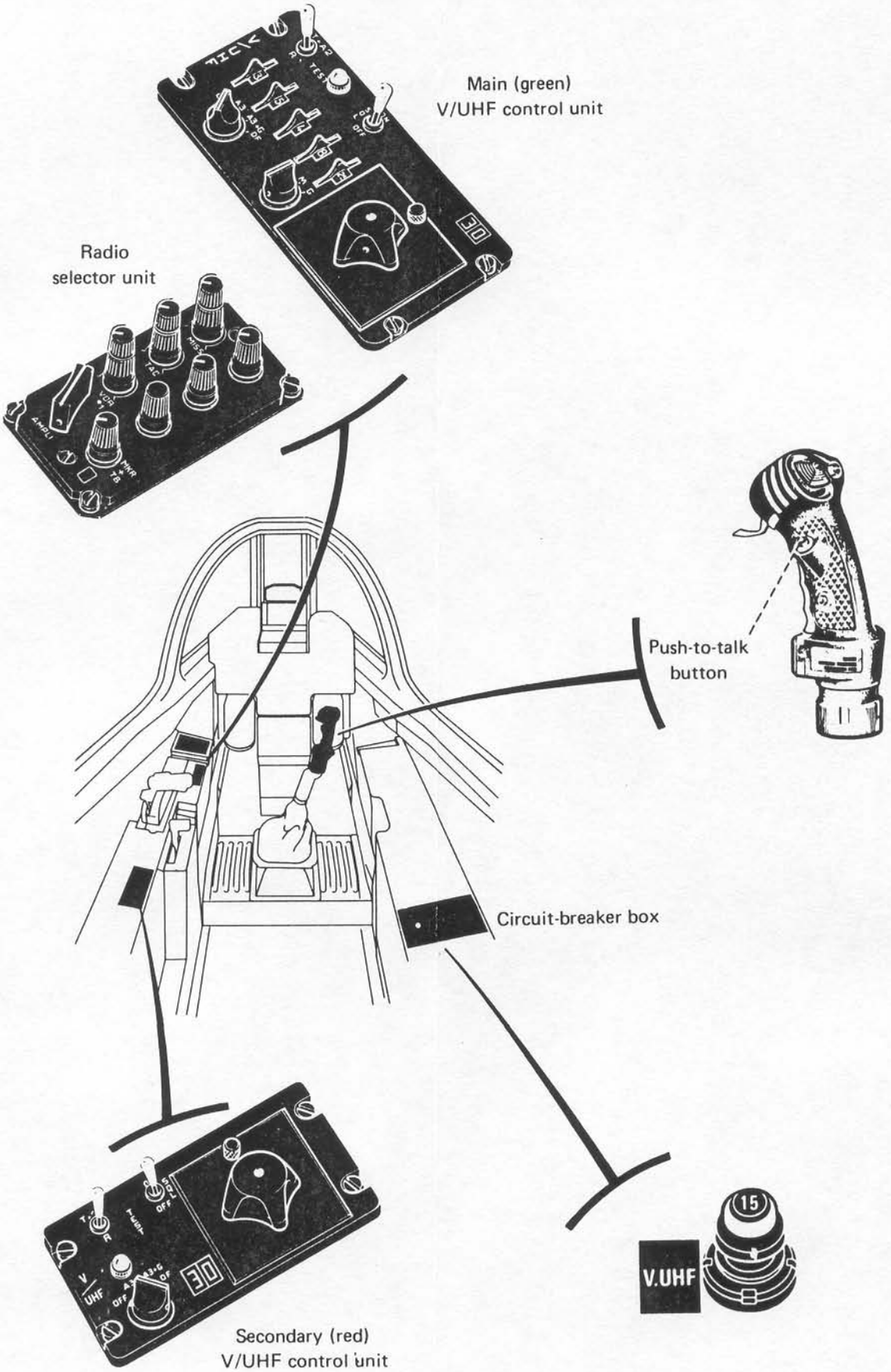


FIGURE 1 - RADIO SYSTEM CONTROLS AND INDICATORS

1,70 – NAVIGATION SYSTEM

1, 70 - NAVIGATION SYSTEM

WARNING

This paragraph gives only a brief description of the equipment. It is dealt with in greater detail in Book 2.

GENERAL DESCRIPTION

The navigation system comprises :

(1) Individual components :

- the TACAN system

  It has 126 channels.
  It is completed by components common to the VOR/ILS system.

- the VOR/ILS system

  It is completed by a marker beacon receiver and components common to the TACAN system.

- the radio-altimeter

(2) Common components :

- radio selector unit
- omnibearing and VOR/ILS-TACAN selector
- spherical indicator
- navigation indicator.

1, 70.1 - TACAN SYSTEM

This equipment permanently gives the polar coordinates of the aircraft in relation to a ground beacon selected by the pilot (magnetic bearing and distance up to 300 NM).

The following controls and indicators are available to the pilot :

1 - ON THE TACAN CONTROL UNIT

- a four-position selector : OFF = off
  REC = use of bearing only
  T/R = use of bearing and distance
  A/A = air-to-air mode
- an X or Y channel selector
- two rotary channel selectors, concentric with the two preceding selectors
- a window for reading the selected channel
- a "WARN" light
- a test button
- a green "GO" light

The built-in test system, initiated by the "TEST" button, enables the "WARN" and "GO" lights to be tested for correct operation, and the TACAN system to be checked for proper operation in the "T/R" and "A/A" modes for the "X" and "Y" channels.

CAUTION

DO NOT PERFORM THE TEST IN FLIGHT, WITH THE AUTOPILOT CONNECTED, IN RADIO/TACAN MODE.

2 - ON THE RADIO SELECTOR UNIT

- a "TAC" potentiometer for adjusting the level of the identification signal of the selected station.

3 - ON THE OMNIBEARING AND VOR/ILS-TACAN SELECTOR

- a three-position selector : off
  VOR/ILS
  TACAN = reception on spherical indicator
- a rotary selector for selecting the magnetic course to reach a TACAN beacon (or an additional target).

4 - ON THE SPHERICAL INDICATOR

- a vertical pointer indicating the deviation between the actual beacon bearing and the selected approach bearing. When this pointer moves out of view to the left, it warns of TACAN bearing failure.
- a window which reads "TO or FROM".

5 - ON THE NAVIGATION INDICATOR

- a double pointer giving the beacon bearing or additional target bearing.
- a window showing the TACAN distance. A bar appears in this window if the distance function of the TACAN receiver is defective.

REMARK : The distance to a VOR/DME beacon can be obtained, without indication of relative bearing, by selecting the channel corresponding to the VOR frequency.

1,70.2 - VOR/ILS SYSTEM - MARKER BEACON SYSTEM

This equipment receives signals from a VOR beacon and ILS signals.

The following controls and indicators are available to the pilot :

1 - ON THE VOR/ILS CONTROL UNIT

- an "ON-OFF" power switch.
- two rotary selector switches for selecting the beacon frequency.
- a window for reading the selected frequency.
- a three-position rotary selector switch for ground and in-flight testing of the VOR and ILS systems.

in the ILS mode :
- "UP/L" (unstable position) : causes the pointers of the spherical indicator to move up and to the left.
- neutral (stable position) : no test (normal operation).
- "DN/R (unstable position) : causes the pointers of the spherical indicator to move down and to the right.

in the VOR mode : selecting either the "UP/L" position or the "DN/R" position (indifferently) displays a VOR course to station of "000" on the navigation indicator (VT selection) and simultaneously, if the course selection is "000", causes the appearance and centring of the spherical indicator left/right pointer, and the indication "TO" to appear in the "TO-FROM" window.

CAUTION

THIS TEST IS VALID ONLY WHEN THE OMNIBEARING AND VOR/ILS-TACAN SELECTOR IS SET TO VOR/ILS AND AFTER SELECTING A VOR OR ILS FREQUENCY DIFFERENT FROM THAT OF ANY STATION CLOSE TO THE AIRCRAFT POSITION.

2 - ON THE RADIO SELECTOR UNIT

- a VOR potentiometer for adjusting the level of the identification signal of the selected station.

3 - ON THE OMNIBEARING AND VOR/ILS-TACAN SELECTOR

- a three-position selector switch :
  - Off
  - VOR/ILS : reception on spherical indicator
  - TACAN
- a rotary selector switch for selecting the magnetic bearing to reach a VOR beacon.

4 - ON THE SPHERICAL INDICATOR

- pointers which indicate :
  - in the VOR mode : deviation between the actual bearing of the beacon and the selected approach bearing.
  - in the ILS mode : aircraft deviations in relation to the glide path and localizer beams.
- a window which shows "TO or FROM".
- a marker beacon light which illuminates when the aircraft flies over marker beacons.

The pointers also serve for failure warning (vertical pointer against L/H stop : VOR-LOC failure ; horizontal pointer against up stop : glide slope failure).

5 - ON THE NAVIGATION INDICATOR

- a mode selector switch, which gives VOR reception in the VT position.
- a single pointer, which gives the VOR course to station if the preceding condition is fulfilled.
- a window on the L/H side, which shows a red flag in case of VOR receiver failure.

6 - THE MARKER BEACON RECEIVER

It is automatically energized when an ILS beacon frequency is selected. The marker beacon light on the spherical indicator can be adjusted for day or night use by means of a concentric selector switch : the light can be tested by depressing the pole setting selector switch. Signal reception level is adjusted by means of the potentiometer pushbutton (TB/MKR) on the radio selector unit.
The marker beacon receiver is tested at the same time as the ILS system and causes a succession of audio signals (400, 1300 and 3000 Hz) and the illumination of the light.

1,70.3 - SPHERICAL INDICATOR

In addition to the TACAN or VOR/ILS - MARKER information, the spherical indicator gives navigation (heading flown) and pitch and roll information (See para. 1,45.1).

NOTE : In case of power supply failure (AC power), positioning to the pole is impossible. A mask, stowed on the R/H console, enables the indicator to be masked ; the "MARKER" light and the sideslip ball remain visible.

1,70.4 - NAVIGATION INDICATOR

The following controls are located around the dial :

- a three-position mode selector switch :

OFF = Off : no indication. The R/H window shows a flag with a cross.
VT = VOR + TACAN indication.
RT = TACAN + Radar antenna bearing repeated by VOR pointer.

- the additional vector controls :
  - a two-position "N-VECT ADD" switch (Normal and additional vector).
  - a dual concentric selector switch :

    The lower section is used to select bearing or distance selection.
    The upper section is used to select the bearing or distance itself.

  - a window showing the bearing selected (0° → 360°).
  - a window showing the distance selected (0 → 299 NM).
- a test button which, when depressed (unstable position), causes the values 45° and 250 NM to appear on the indicator if the test is satisfactory. In the additional vector mode, the information shown takes account of the values selected.

The dial, which displays navigation information, comprises :

- all the navigation and interception indications (See table)
- a fixed index representing the aircraft lubber line
- a ± 60° sector representing the deflection sector of the radar antenna
- the 45° and 250 NM markings used for the test

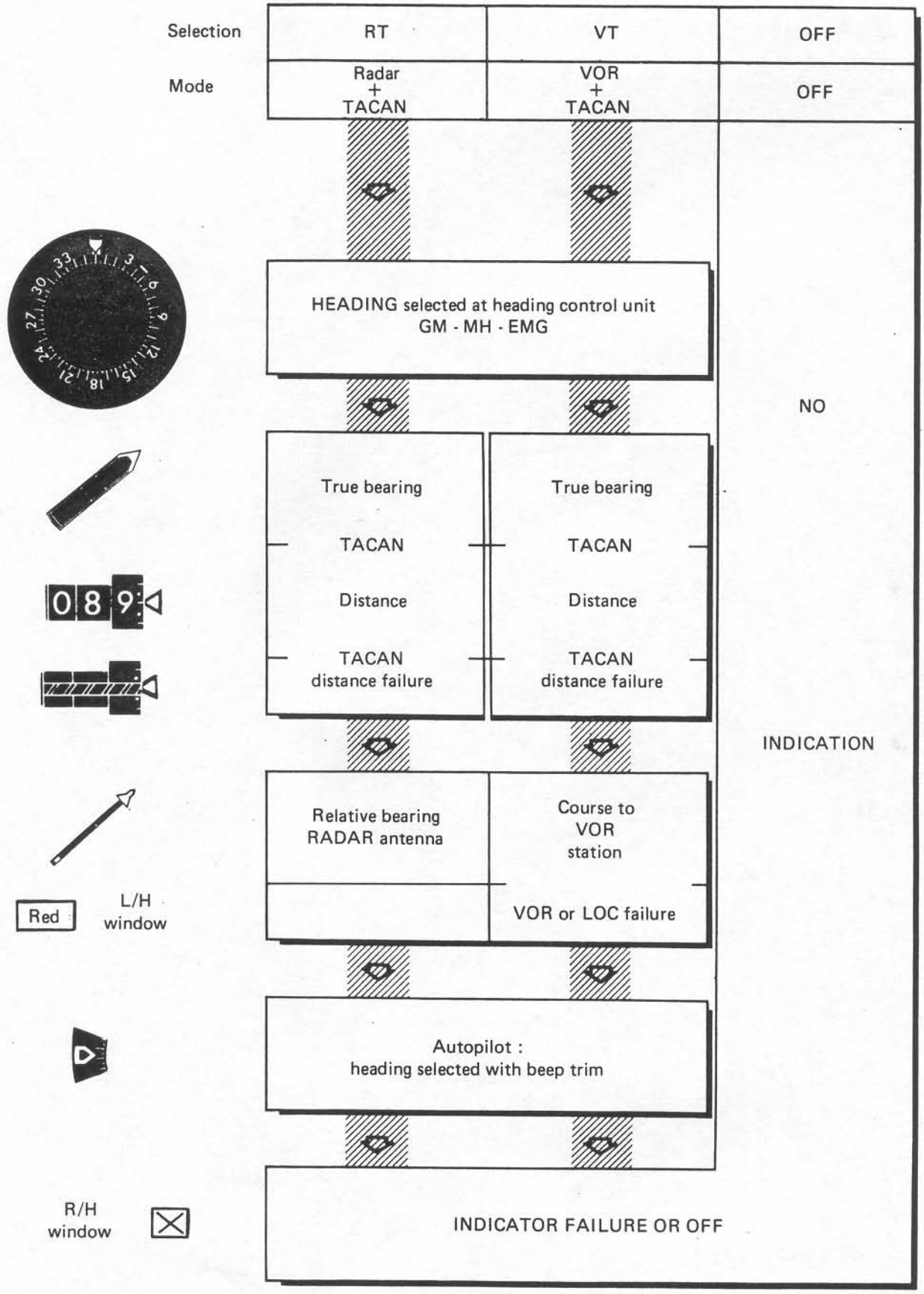


FIGURE 1 - NAVIGATION INDICATOR

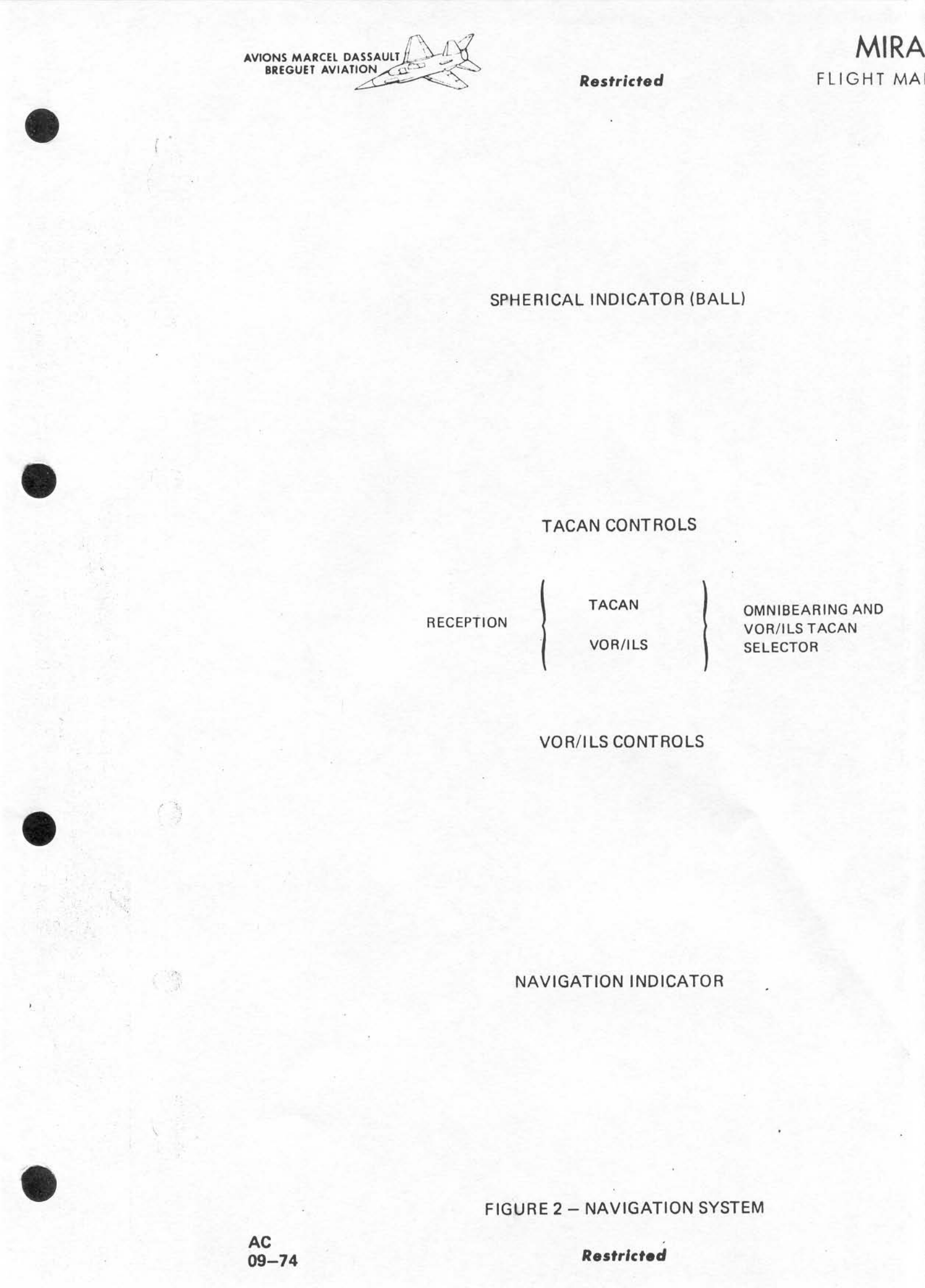


FIGURE 2 – NAVIGATION SYSTEM

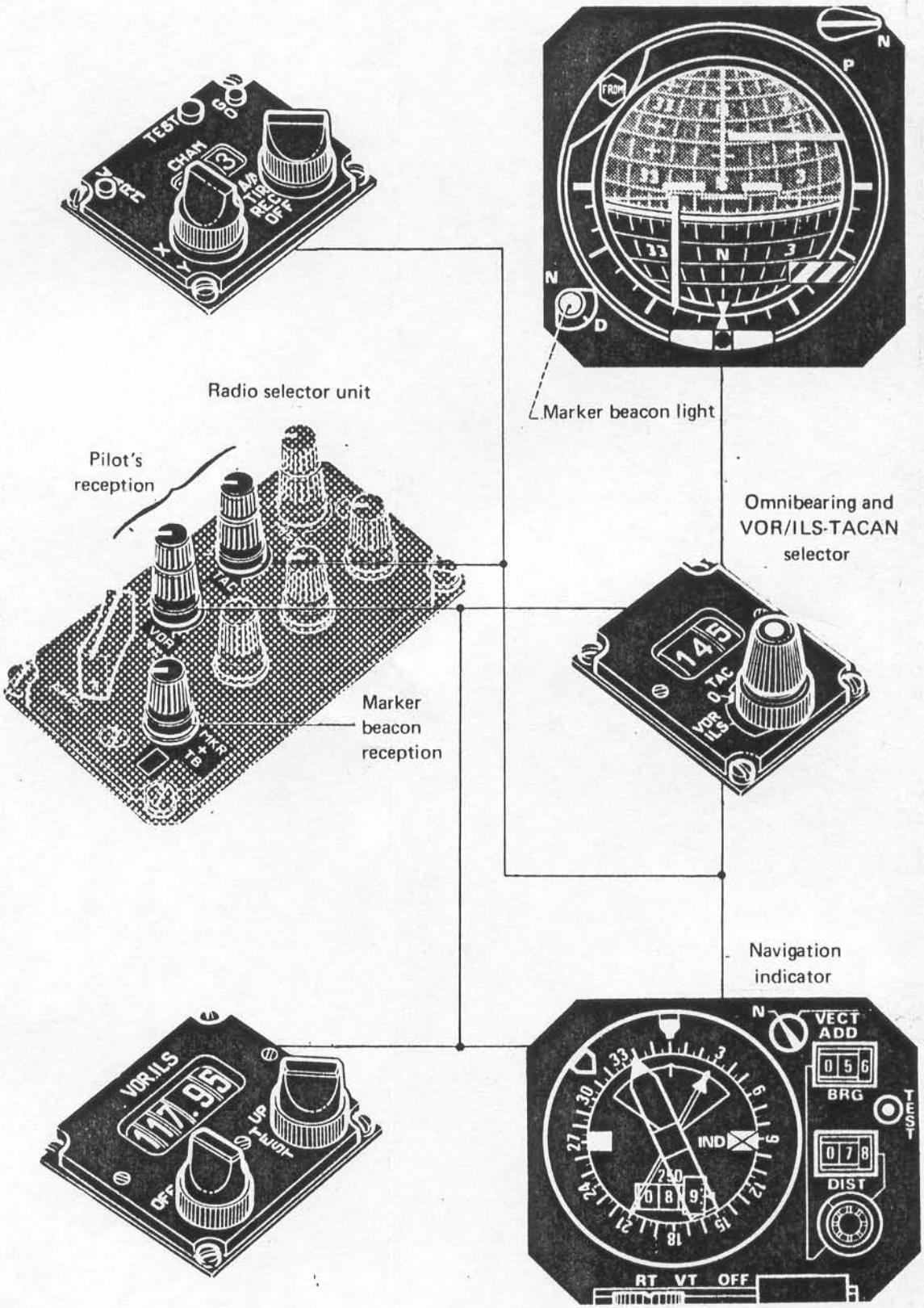


FIGURE 2 - NAVIGATION SYSTEM

1,70.5 - RADIO-ALTIMETER

The radio-altimeter is a system which measures and displays the altitude of the aircraft above the ground, independently of the atmospheric pressure.

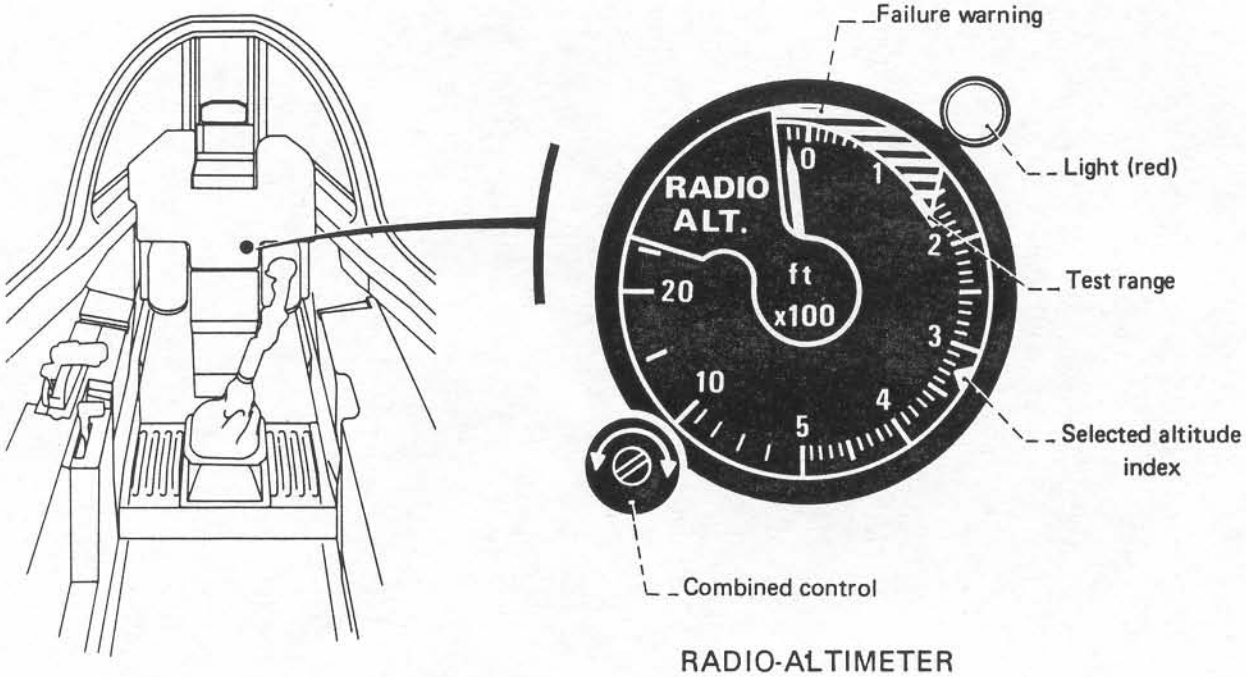
The indicator on the instrument panel features :

- a combined control which :
  - when rotated, switches the equipment on or off and displays the selected altitude
  - when depressed, tests the equipment
- a dial graduated from -20 to 2500 ft, comprising :
  - a linear scale from -20 to 500 ft
  - a logarithmic scale from 500 to 2500 ft
- an altitude pointer
- a red selected altitude index
- a red light used for the test and for the selected altitude
- a test range from 140 to 180 ft represented by a green arc
- a cover which masks the pointer at high altitudes and when failures occur
- a failure warning flag showing white stripes on a red background.

The radio-altimeter also supplies information to :

- the sight computer
- the autopilot.

NOTE : The radio-altimeter test is not possible when the autopilot is operating in the glide slope mode.



RADIO-ALTIMETER

FIGURE 3 - RADIO-ALTIMETER

1,75 – OPERATIONAL EQUIPMENT

1,75 - OPERATIONAL EQUIPMENT

1,75.1 - CONTROLS AND INDICATORS

ITEM		NAME	DESCRIPTION	REMARKS
I F F	Master control	"MASTER" selector switch	"OFF" : power supply cut off "SBY" : warm-up position "N" : normal position "EMG": transmission of a special distress signal	When the seat is ejected, a distress switch triggers continuous IFF transmission, irrespective of the position of the selector switch
	Mode 1	M-1 selector switch	On - Off	
		Code selector switches	Code selection	
	Mode 2	M-2 selector switch	On - Off	Coding is adjusted on ground
	Mode 3	M-3A-B selector switch	On - Off	
		Code selector switches		
	Mode C	M-C selector switch	On - Off	Associated with slaved altimeter
	ORSA computer			See separate documentation
	Identification	Switch	"IDENT" : instantaneous position identification "OUT" : off "MIC" : identification when push-to-talk button is depressed	Unstable position with automatic return to "OUT" Stable position
	Test	"TEST" button		
		"FAULT" light		
	Indicating	IFF light		Amber
	Protection	IFF circuit-breaker		
	RADAR	RADAR selector switch	"OFF" : power supply cut off "STBY" : standby "TX" : transmission	
	SIGHT	SIGHT selector switch	"OFF" : power supply cut off "ON" : sight energized "APP" : approach function with velocity vector	
	SEARCH LIGHT	Search light switch	Energization	(can be used in flight only)
		Search light button	Illumination	
	BF RADAR DETECTOR	BF radar detector switch	On - Off	

WARNING

This paragraph gives only a brief description of the equipment. It is dealt with in greater detail in Book 2.

1,75.2 - DESCRIPTION - OPERATION

1 - IFF SYSTEM

The transponder forms part of an assembly designed for the identification, friend or foe, of an aircraft ; the other component of this assembly being an interrogator radar.
When interrogated on a mode, the IFF replies by a series of coded RF pulses. It can also be used for the following functions :

- transmission of aircraft altitude (Mode C).
- transmission of coded information (through the ORSA computer).

2 - RADAR

The CYRANO IV SIRAS radar is designed to perform :

- Air-Air interception mission at high and medium altitudes, permitting :
  - detection and tracking of an airborne target.
  - determination of the interception flight path.
  - computation of the firing zone of the selected weapon.
  - determination of the flight path after firing.
  - computation of the break-away moment and flight path.
  - blind gun firing.
  - rendez-vous.
- reconnaissance of the ground overflown by displaying a representation of the ground in front of the aircraft on the radar scope.

On the pilot's command, the radar locks on to the target.
It then generates approach commands which are displayed in the sight head at the same time as the distance and closing velocity.
It computes the firing zone and can trigger firing automatically.
It also generates break-away commands during missile firing.
The radar operates in association with the sight and the armament control panel.
It receives information from the gyro centre and the air data computer.

3- SIGHT

The sight displays to the pilot the following indications in the form of luminous images projected to infinity :

- aiming marks
- steering commands
- steering information :
  - horizon
  - heading or aircraft/target distance
  - altitude or closing velocity
  - radar antenna direction
  - attack phase lights

The sight is designed for the following functions :

- interception : air-to-air missiles
  guns, blind or visual firing
- interrogation
- air-to-ground
- approach

The sight can be equipped with an electric camera which films the sighting and the firing results, if any.
The camera is automatically adjusted by a photoelectric cell.

4- SEARCHLIGHT

A fixed searchlight (adjustable on the ground) is mounted in the LH side of the fuselage ; it illuminates forward on a relative bearing of 42° to port (22° after incorporation of modification No. 496).
A microswitch on the nose U/C cuts off the power supply when the nose U/C is extended.

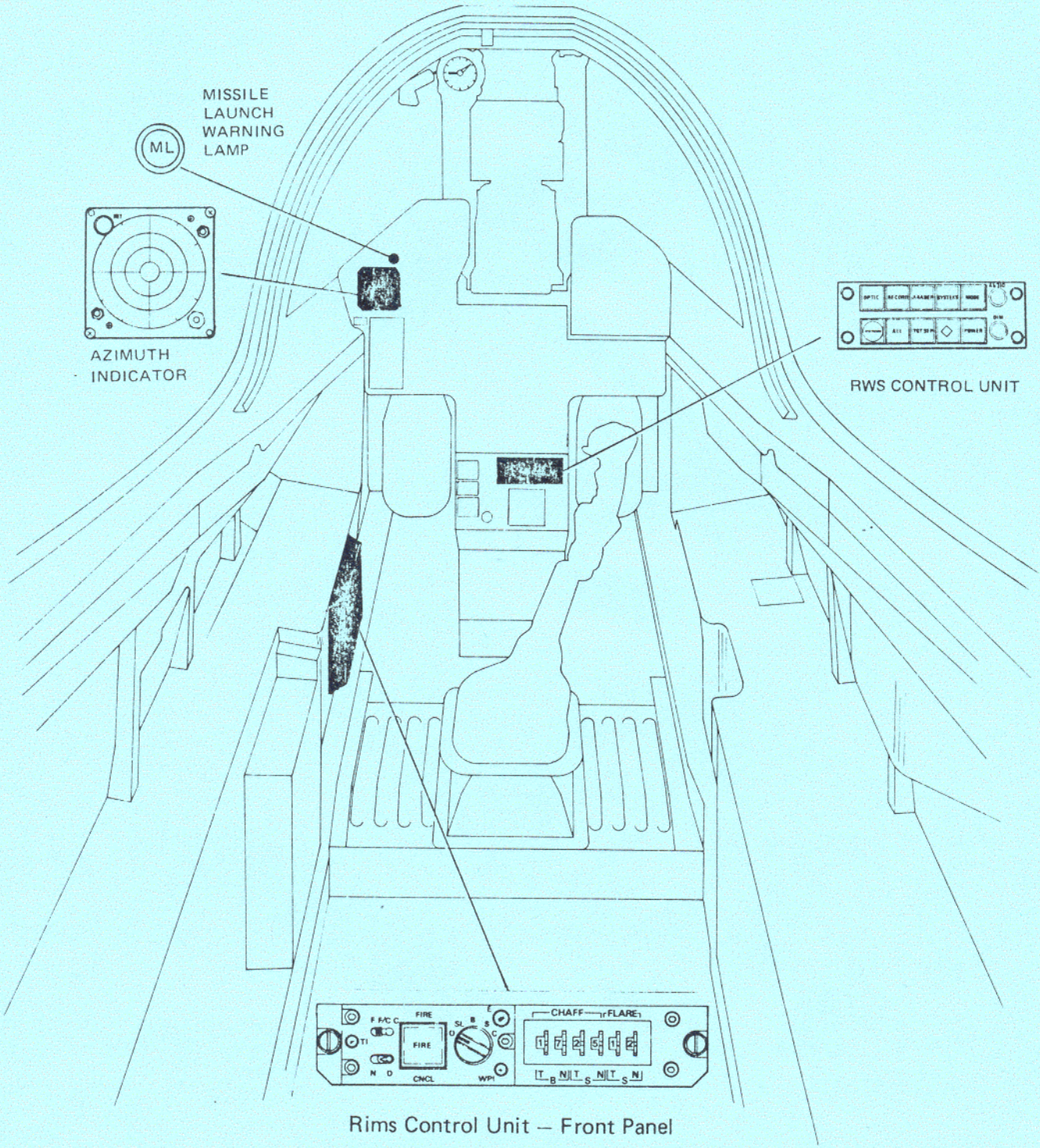
The light is operated by turning the «SEARCH LT» switch «ON» and depressing the control stick grip button. The light remains on as long as the button is held depressed.
When the light is no longer necessary, turn the switch back «OFF» (15-minute maximum continuous operating time and 45-minute off time).

5- BF RADAR DETECTOR

The BF radar detector gives the pilot an omnidirectional warning (visual and aural) and an indication of the direction and nature of the threat when the aircraft is illuminated by a tracking or fire control radar.

5 – RADAR WARNING SYSTEM (R.W.S.) POST/SAAF/MOD/MIR/282

The radar warning system, replacing the BF radar detector, gives the pilot an omnidirectional warning (visual and aural) and an indication of the direction and nature of the threat when the aircraft is illuminated by a tracking or fire control radar.



Rims Control Unit – Front Panel

FIGURE 1A – OPERATIONAL EQUIPMENT
CONTROLS AND INDICATORS
(POST/SAAF/MOD/MIR/281, 282)

FIGURE 1 – OPERATIONAL EQUIPMENT
CONTROLS AND INDICATORS

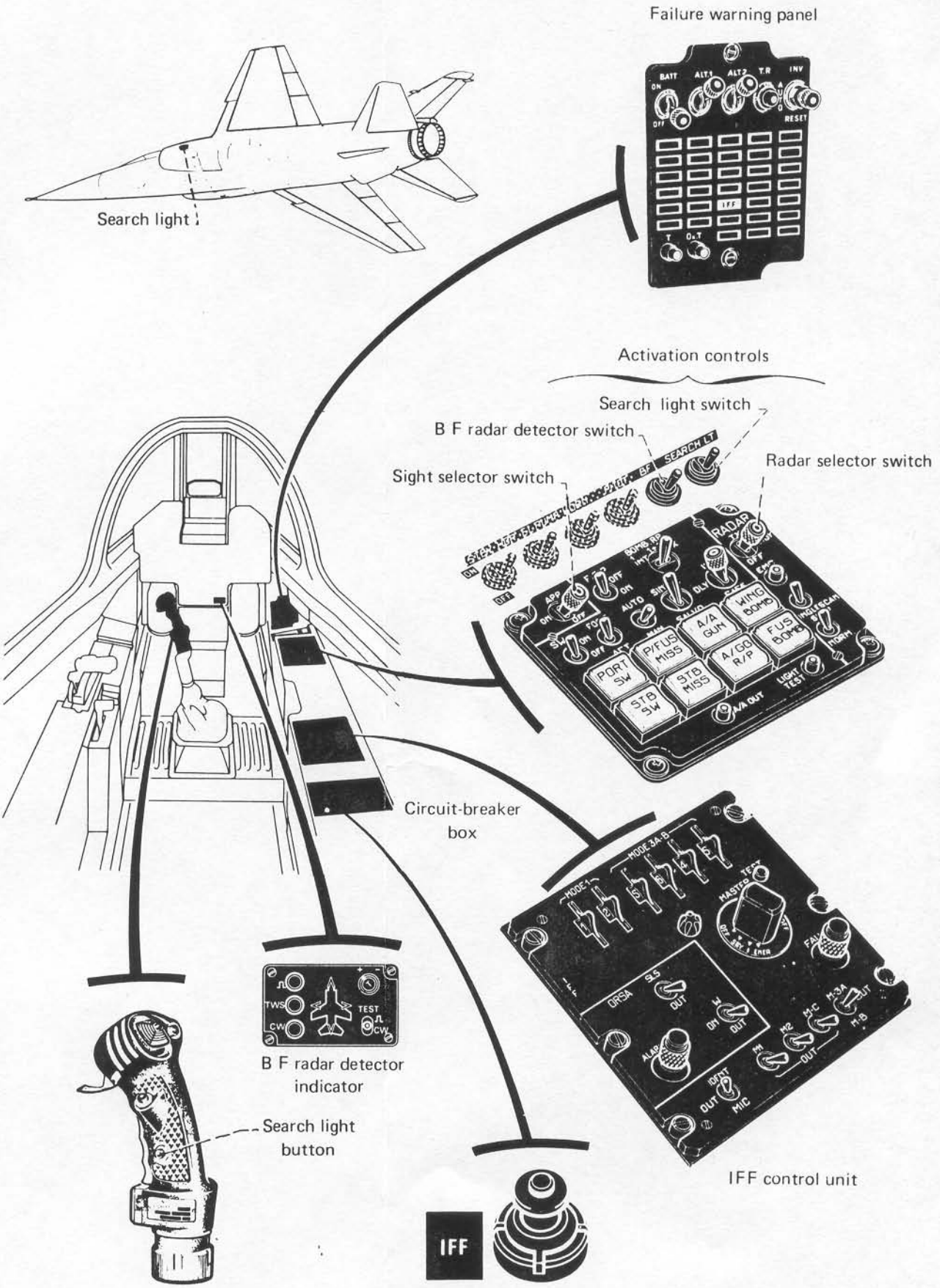


FIGURE 1 - OPERATIONAL EQUIPMENT CONTROLS AND INDICATORS

1,80 – ARMAMENT

1,80 - ARMAMENT

WARNING

This paragraph gives only a brief description of the armament. It is dealt with in greater detail in Book 2.

1,80.1 - GENERAL

For all missions, the aircraft is equipped with two 30-mm guns.
The wing and fuselage loading stations enable the aircraft to carry various loads or stores (See Figure 2, page 1.10-3).

1,80.2 - ARMAMENT CONTROLS

The following controls are available to the pilot :

- an armament master switch (under a guard and with a safety cover).
  It is duplicated by the U/C safety, consisting of a microswitch in the L/H U/C well (actuated by the U/C leg), which prohibits firing when the U/C is down.
- firing controls on the control stick handgrip :
  - a firing trigger which actuates the gun button.
  - a rocket/bomb/missile button which is protected by the firing trigger when it is in the inoperative position.
    These two controls also trigger the sight camera.
- an armament control panel, including :
  - the various armament selection pushbuttons, permitting :
    - radar computer mode selection for the AIR-AIR modes (the AIR-GROUND mode of the radar is directly controlled by setting the radar scope mode selector switch to the "GM" position, irrespective of the positions of the pushbuttons).
    - sight mode selection :
      AIR-AIR or AIR-GROUND, according to the armament selected (when none of the pushbuttons are depressed, the sight operates in the navigation mode).
  - the following armament circuit controls :
    - AIR-AIR missile circuit
    - type of bomb arming
    - selection of loading stations
    - selection of firing mode.
  - the fuel dipper switch.

Apart from the normal firing controls, three buttons control the jettisoning of stores (See para. 1,50.5).

FIGURE 1 – ARMAMENT CONTROLS AND INDICATORS

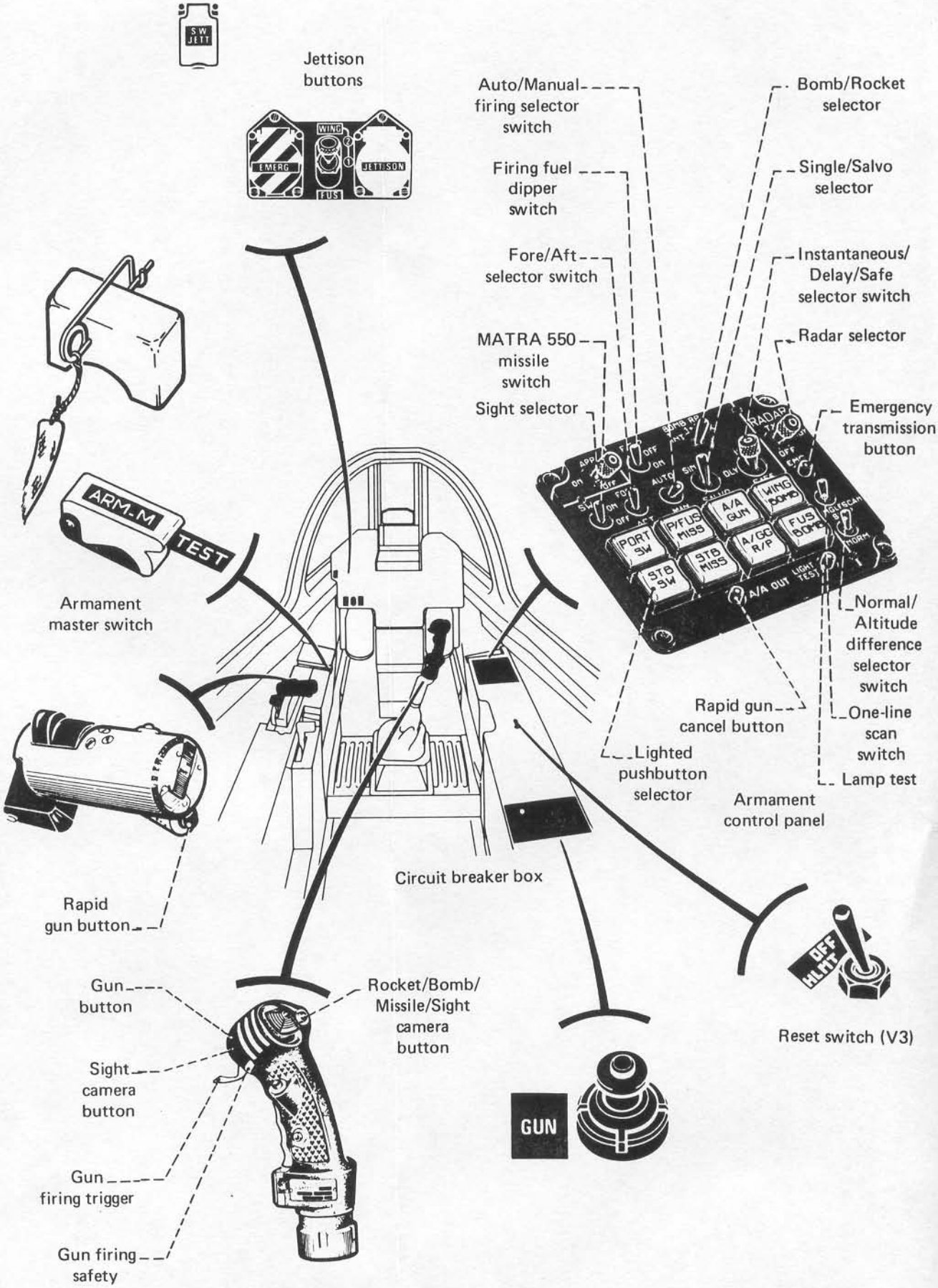


FIGURE 1 - ARMAMENT CONTROLS AND INDICATORS

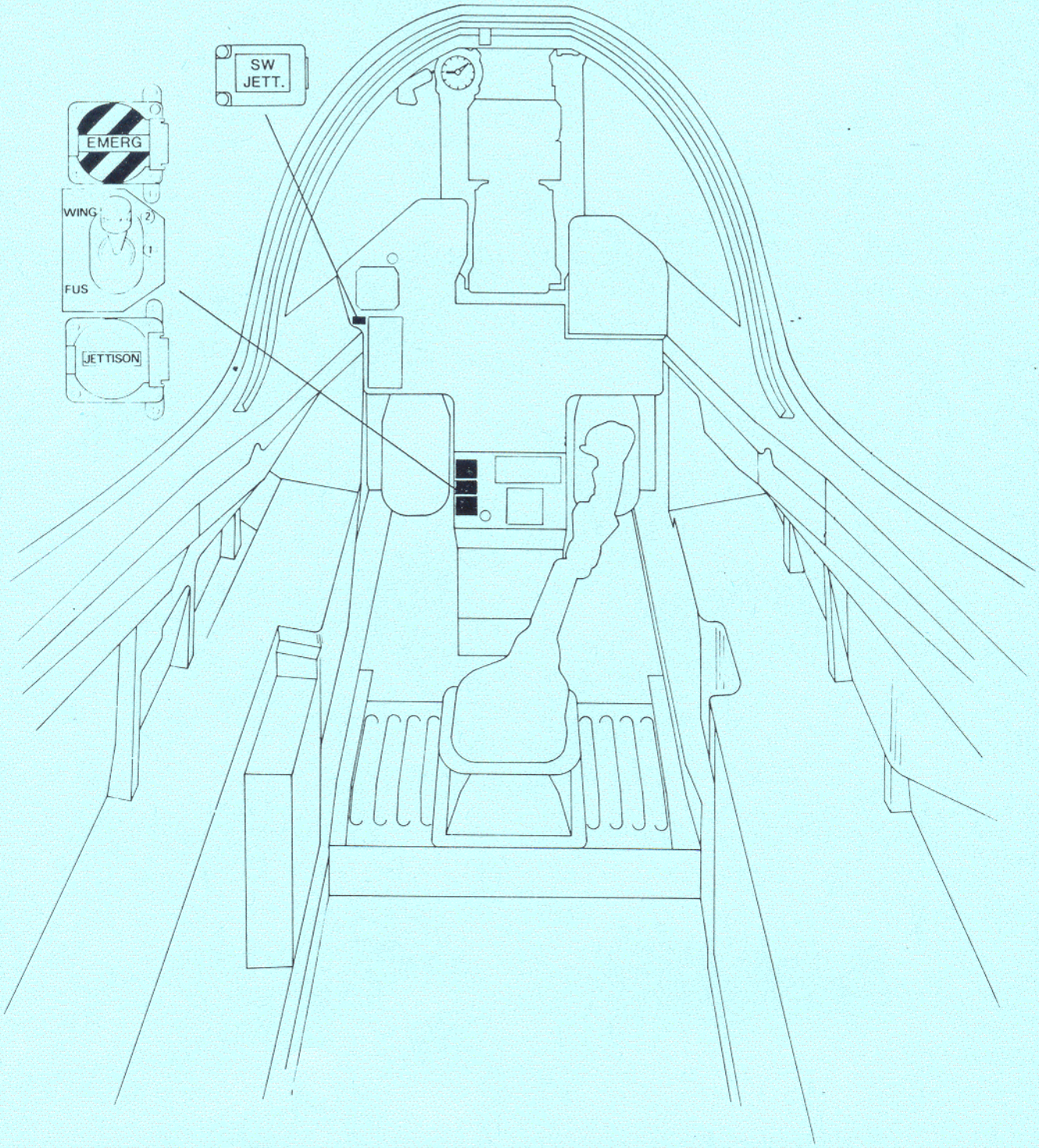


FIGURE 1A – ARMAMENT CONTROLS AND INDICATORS
POST/SAAF/MOD/MIR/282)

TP 0582

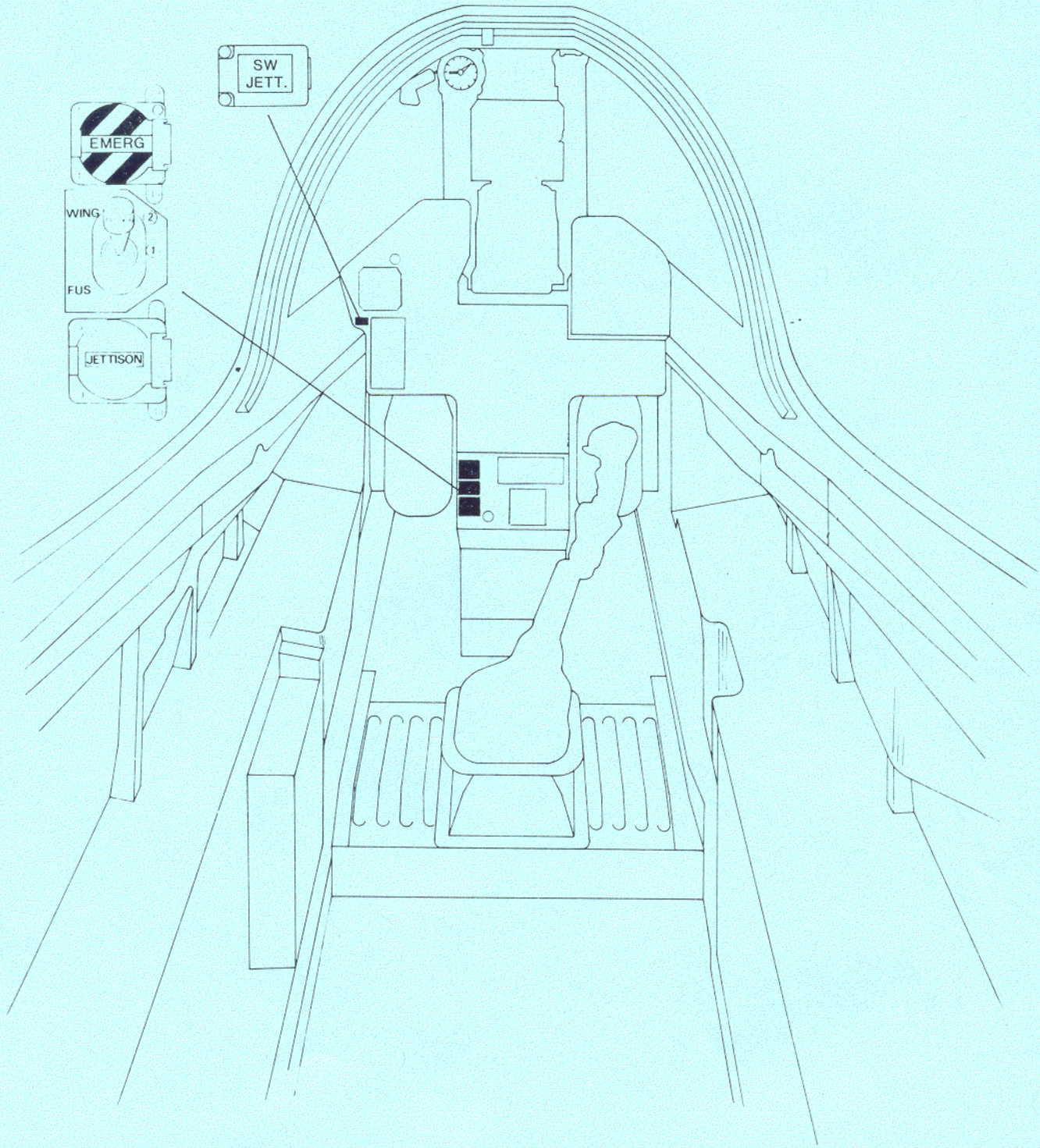


FIGURE 1A – ARMAMENT CONTROLS AND INDICATORS
POST/SAAF/MOD/MIR/282)

TP 0582

Section 2

NORMAL PROCEDURES

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2,10 - BEFORE STARTING

2,10.1 - EXTERIOR INSPECTION

6 – RH MAIN U/C
- Condition of tires
- Height of shock strut
- Engine access door locked
- U/C uplock checked (open)

5 – GROUND SAFETY DOOR
- Check role change circuit test is in accordance with external stores carried
- Close door

4 – RH AIR INTAKE
- Same as for LH air intake

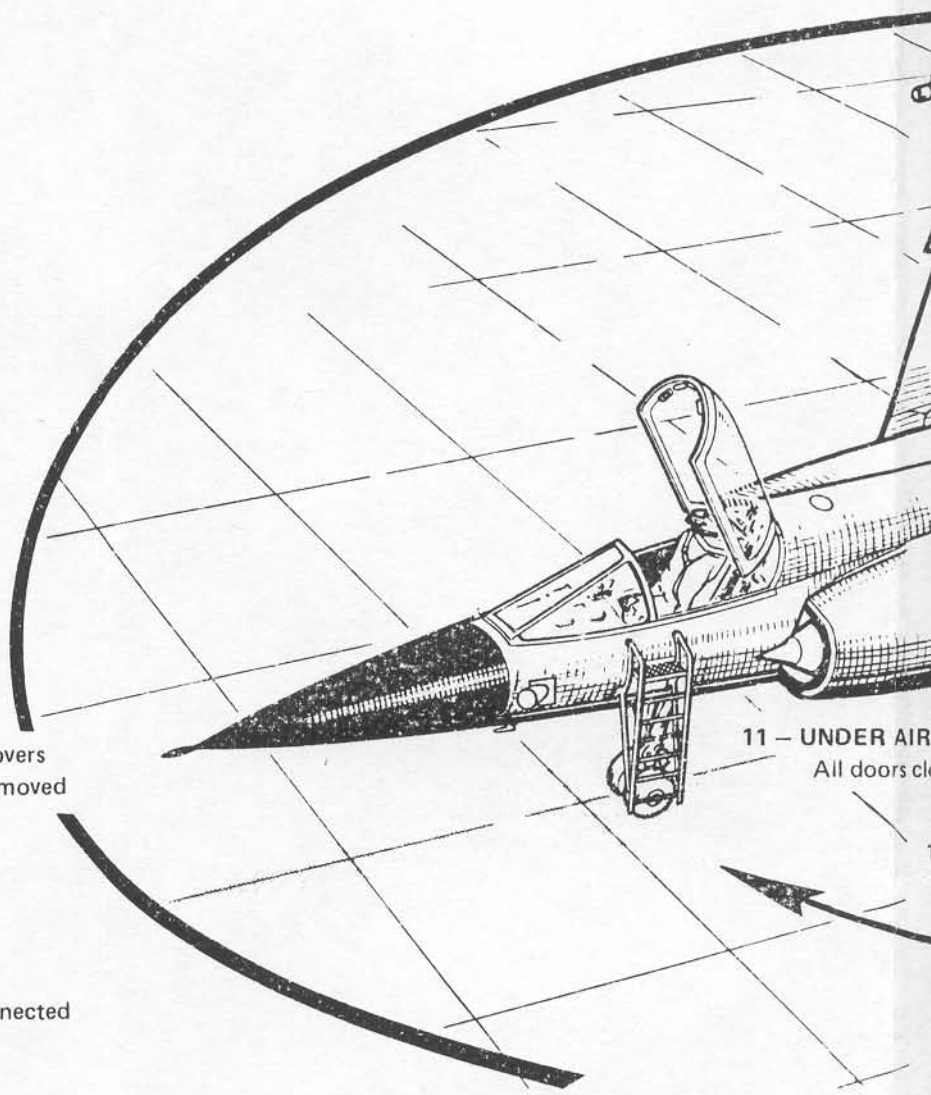
3 – FORWARD FUSELAGE SECTION
- Angle-of-attack probe
- Temperature probe
- Pitot probes
- Static ports

} Covers removed

2 – NOSE U/C
- Torque links and electrical plugs connected
- Condition of tires
- Height of shock strut
- U/C uplock checked (open)

7 – RH WING 8
- General condition of structure
- Attachment of external stores
- Condition of position light
- Condition of control surfaces:

Slats	: up
Aileron	
Flaps	: up
Spoilers	: in



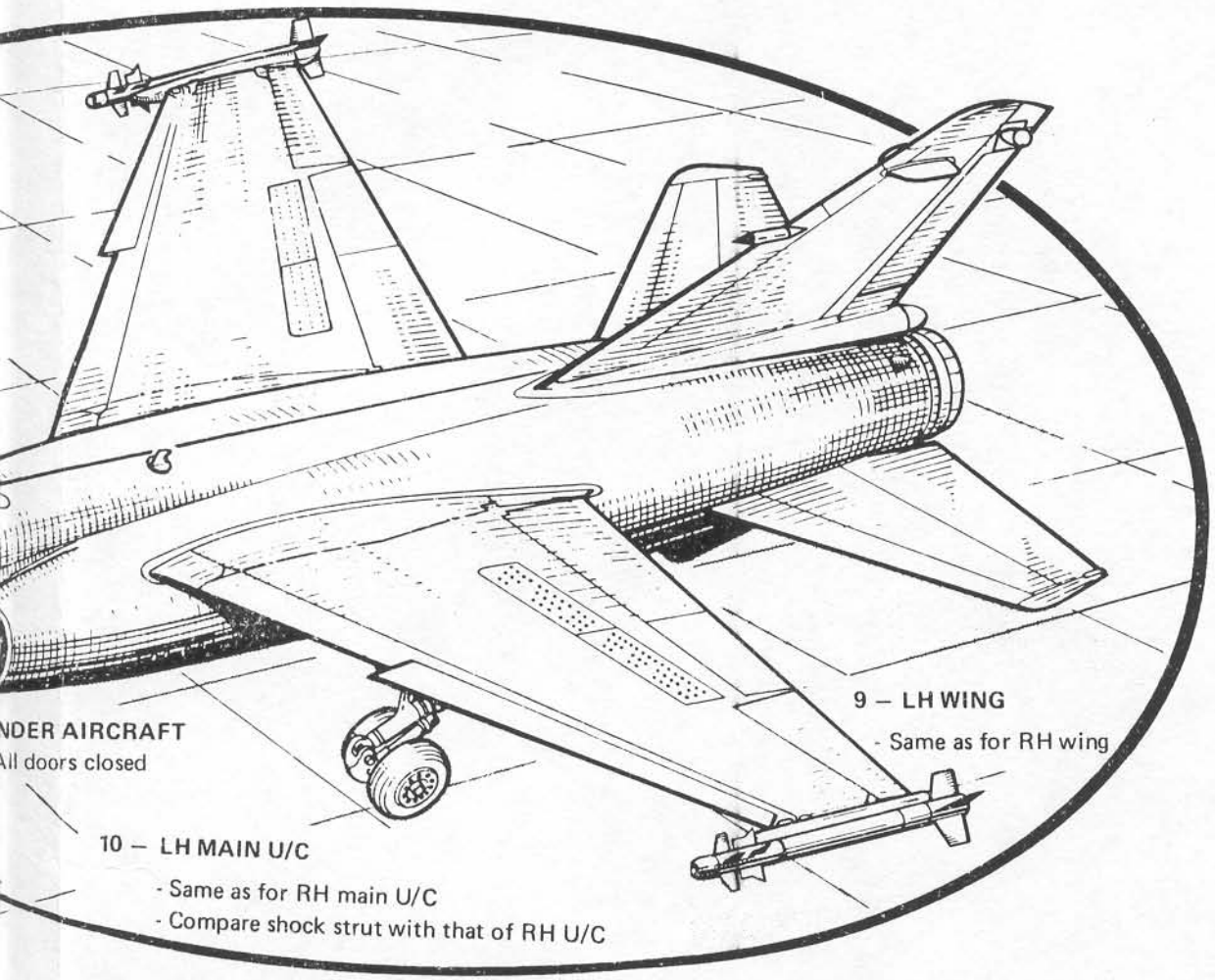
11 – UNDER AIR
All doors cl

0

1 – LH AIR INTAKE
- Cover removed
- No foreign matter
- Shock cone in (tip checked)
- Operation of additional air intake doors

8 – AFT FUSELAGE SECTION

- General condition of structure
- Condition of control surfaces
- No oil or fuel accumulation on lower sections of exhaust nozzle flaps
- Brake chute in position : safety pin removed, locking pin
- Ventral fins : RIMS dispensers fitted


NDER AIRCRAFT
All doors closed
9 – LH WING
- Same as for RH wing
10 – LH MAIN U/C
- Same as for RH main U/C
- Compare shock strut with that of RH U/C

0 – ON ARRIVING AT AIRCRAFT

The pilot checks:

- Seat safety pins in position
- Canopy shear knife in position
- All circuit breakers pushed in
- Battery off
- "ARM.M." switch guarded (cover in place)
- Gun firing trigger folded aft, trigger safety in position
- Oxygen valves closed, emergency pressure correct
- RIMS Control Unit fitted
- The pilot removes the seat alternative firing handle safety pin and lets it hang outside along the fuselage

FIGURE 1A – EXTERIOR PREFLIGHT INSPECTION
(POST/SAAF/MOD/MIR 281, 282, 294)

2,10 - BEFORE STARTING

2,10.1 - EXTERIOR INSPECTION

7 – RH WING

- General condition of stru
- Attachment of external s
- Condition of position lig
- Condition of control surf

6 – RH MAIN U/C

- Condition of tires
- Height of shock strut
- Engine access door locked
- U/C uplock checked (open)

5 – GROUND SAFETY DOOR

- Check that door is closed

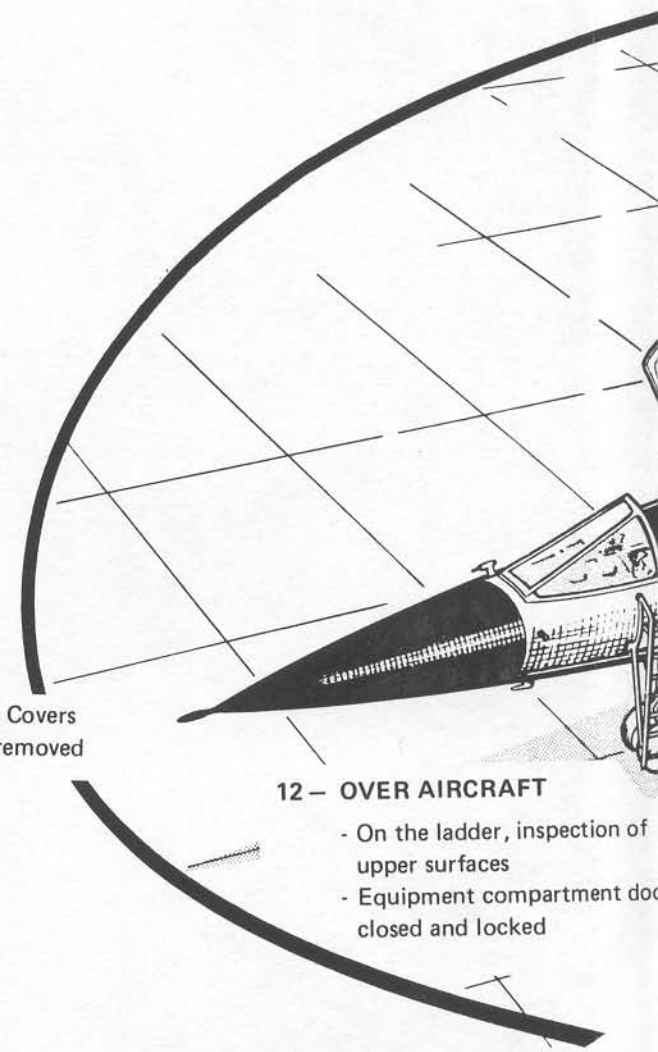
4 – RH AIR INTAKE

- Same as for LH air intake

3 – FORWARD FUSELAGE SECTION

- Angle-of-attack probe
- Temperature probe
- Pitot probes
- Static ports

Covers removed



12 – OVER AIRCRAFT

- On the ladder, inspection of upper surfaces
- Equipment compartment doo closed and locked

2 – NOSE U/C

- Torque links and electrical plugs connected
- Condition of tires
- Height of shock strut
- U/C uplock checked (open)

1 – LH AIR INTAKE

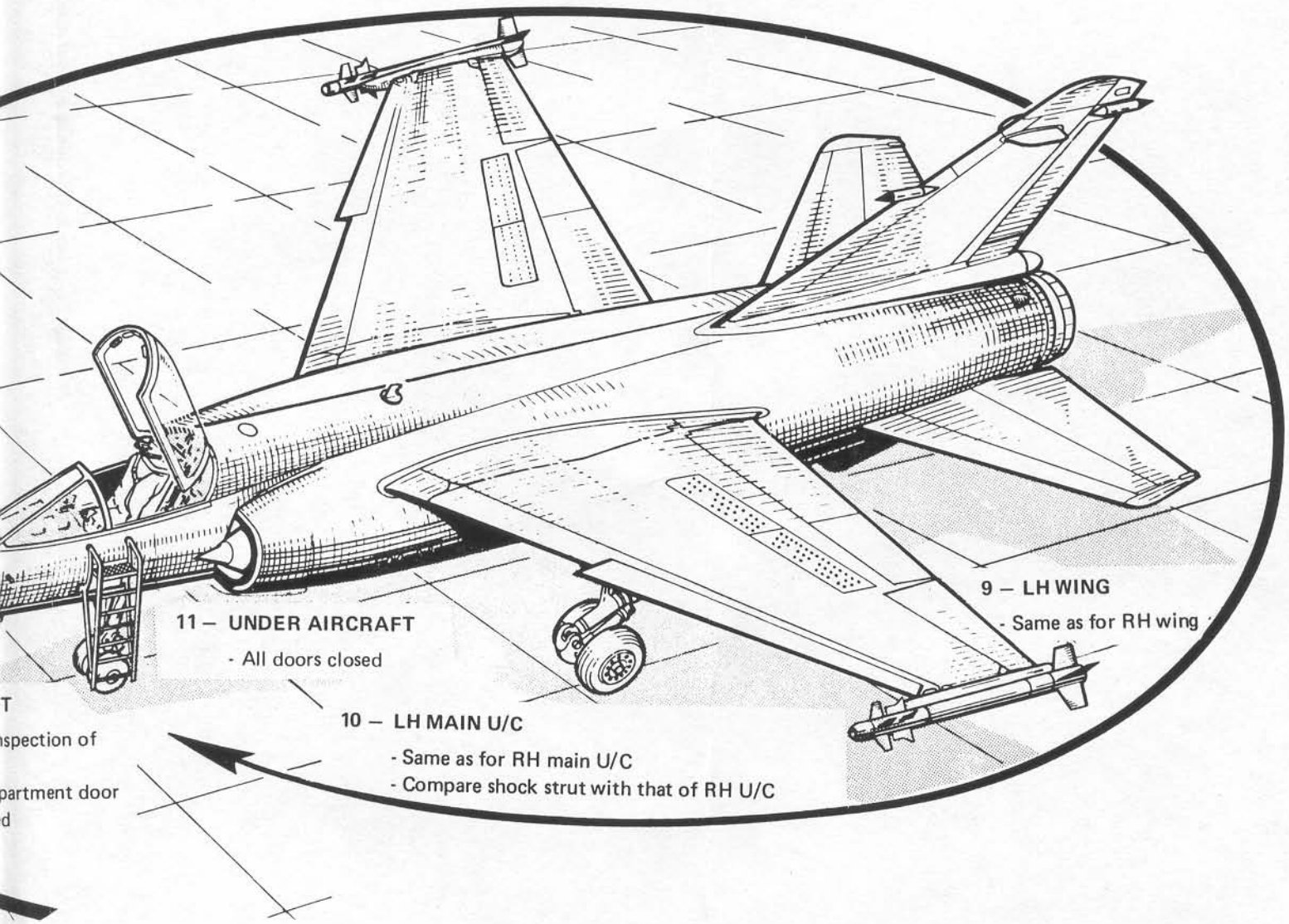
- Cover removed
- No foreign matter
- Shock cone in (tip checked)
- Operation of additional air i

FIGURE 1 – EXTERIOR PREFLIGHT INSPECTION

dition of structure
of external stores
f position light
f control surfaces : Slats : up
Aileron
Flaps : up
Spoilers : in

8 – AFT FUSELAGE SECTION

- General condition of structure
- Condition of control surfaces
- No oil or fuel accumulation on lower sections of exhaust nozzle flaps
- Brake chute in position : safety pin removed, locking pin
- No play at ventral fins



11 – UNDER AIRCRAFT

- All doors closed

9 – LH WING

- Same as for RH wing

10 – LH MAIN U/C

- Same as for RH main U/C
- Compare shock strut with that of RH U/C

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tip checked)
ditional air intake doors

0 – ON ARRIVING AT AIRCRAFT

The pilot checks :

- Seat safety pins in position
- Canopy shear knife in position
- All circuit breakers pushed in
- Battery off
- "ARM.M." switch guarded (cover in place)
- Gun firing trigger folded aft, trigger safety in position
- Oxygen valves closed, emergency pressure correct
- The pilot removes the seat alternative firing handle safety pin and lets it hang outside along the fuselage

2,10.2 - ENTERING CABIN

- Set the parking brake.
  The battery will be connected only after ground crew has cleared aircraft and removed access ladder.
- Adjust the rudder pedals.
- Strap-in by proceeding as follows :
  . Connect the survival pack by attaching the lowering line to the D-ring.
  . Connect the anti-g trousers.
  . Attach the calf straps slightly above the calves with the loops outboard.
  . Pass the L/H restraining strap through the L/H calf strap ring, then connect the cone to the R/H lock. In the same manner, pass the R/H restraining strap through the R/H calf strap ring, then connect the cone to the L/H lock.
  . Check that full travel of the rudder pedals is not impaired ; otherwise, adjust calf strap length (pull-rings under the seat).
  . Position the back cushion.
  . Attach the lap straps to the lower corners of the quick-release box (*) and tighten them (L/H lap strap passing over the lowering line).
  . Attach the negative-g strap to the bottom of the quick-release box (*).
  . Pass the groin straps through the lap strap rings (L/H strap passing under the lowering line).
  . Pass the shoulder straps through the groin straps and attach them to the upper corners of the quick-release box (*).
  . Slide the groin strap loops against the quick-release box on the shoulder strap metal hooks.
  . Tighten the negative-g strap, then tighten the shoulder straps.

  (*) Thoroughly check the attachment of the straps to the quick-release box : engage each fitting fully home, using care to hold the latches positively withdrawn. The hook locking click should be heard. After engagement of the last fitting, press again the latches as a safety measure.

WARNING

NEVER MANIPULATE THE QUICK-RELEASE BOX IN FLIGHT

  . Unlock the harness and lean forward :
  the ground crew adjusts the shoulder straps ; check the harness for locking.
  . Retighten the shoulder straps.

- Put on the headset.
- Connect the mask hose to the connector ; carefully check for proper end-piece locking.
- Attach the connector to the R/H shoulder strap by means of the clip.

The ground crew :
- opens the oxygen cocks : NORMAL then EMERGENCY
- opens the anti-g valve (trousers inflation test).

- Attach the mask.

The ground crew :
- removes the safety cover from the armament master switch
- removes the five seat safety pins
- SHOWS THEM TO THE PILOT WHO COUNTS THEM
- stows them
- helps the pilot to close, or partially close, the canopy
- removes the access ladder.

- Switch on the battery and the warning horn.
- Adjust the seat height.
- Check the oxygen :
  - 0x REG and 5mn 0x lights out
  - gauge in the green range : (depress the oxygen quantity ground test button)
  - selector switch on normal : "N" visible on magnetic indicator, blinker operating
  - selector switch on "EMG" : red square visible on magnetic indicator, overpressure is felt
  - selector switch on "100 %": white square visible on magnetic indicator.

Sight Lighting selector switch : N
Intensity selector switch : AUTO

Sight camera : overrun and framing rate selected
STANDBY ALTIMETER : SET
Spherical indicator : N/P selector switch to N
Standby horizon : caged (Flag visible)

2,10.3 - CABIN CHECK

Clock : wound and set
Incidence indicator : intensity adjusted

LIGHTS { Combat flaps
Configuration indicator
U/C not-down
Airbrakes
Engine and A/B fire + Warning horn
Autopilot (if GPU connected) } TESTED

Residual pressure light : on
Mach/Airspeed indicator : zero (index set)
RPM indicator : zero
Azimuth indicator : OFF
Missile launch lamp : OFF

A/B + SRL LIGHTS : TESTED
Slaved altimeter : red flag visible
JPT indicator : pointer below scale
Vertical speed indicator : zero
SW Jettison button : guarded

Canopy jettison or embrittle control : aft (safetied)
Brake chute control : forward, lever tip up, marks aligned

STANDBY LIGHT (CONDITIONING DOOR) : TESTED
Stick uncouple switch : off (guarded)
Pitch switch : PITCH
Yaw/Anti-slip switch : ANTI-SLIP
ARTHUR selector switch : AUTO (guarded)
U/C CONTROL LEVER : DOWN, SAFETY CLEARED
Incidence Probe switch : as required

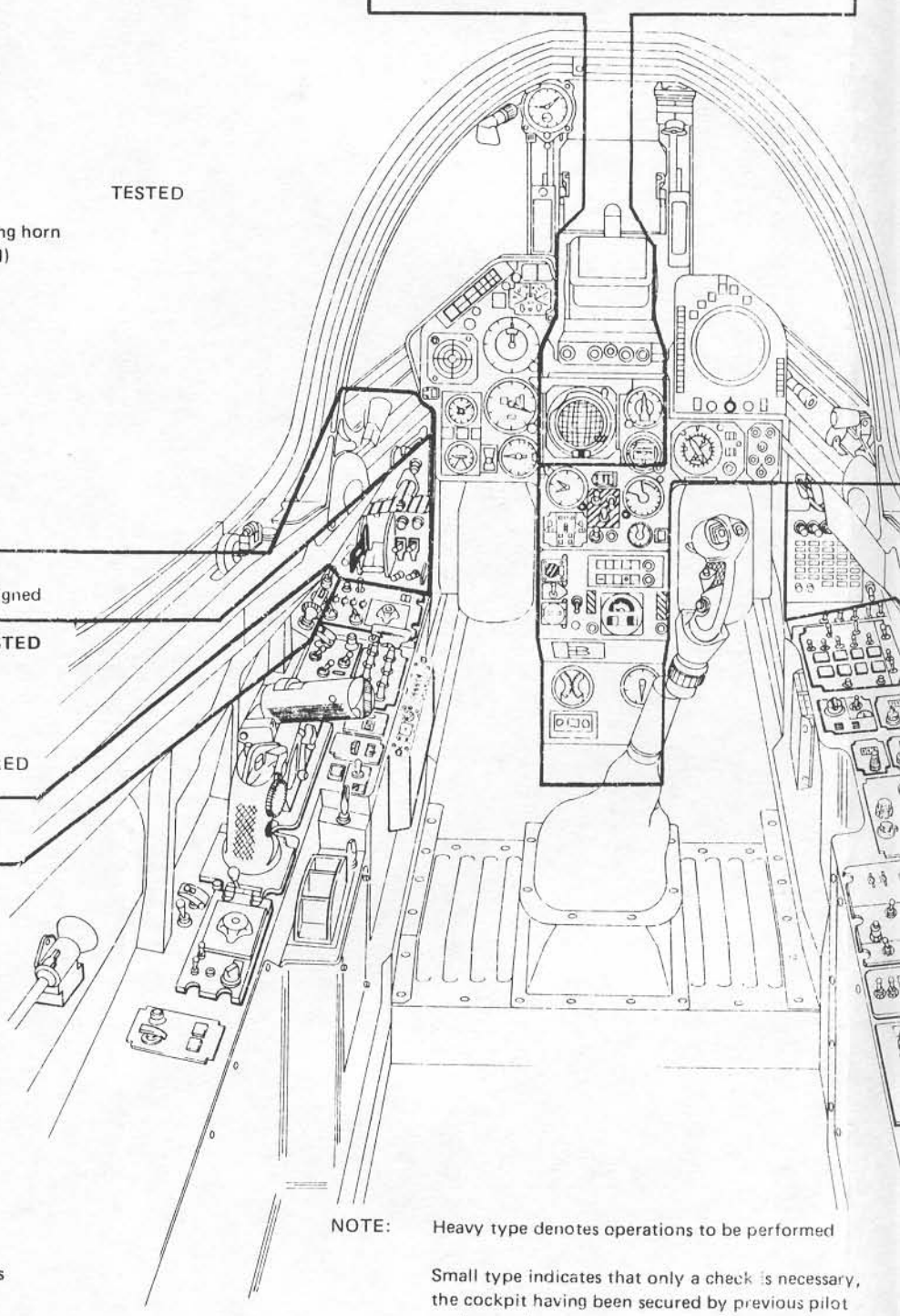
Landing light control : OFF
Emergency regulation switch : off (guarded)

V/UHF (green) : as required
Armament master switch : off (guarded)

RADIO SELECTOR UNIT : SET
EMERGENCY REGULATION LIGHT : TESTED

LP main cock switch : closed (unguarded)
L/H and R/H LP pump switches : off
Starting pump switch : off
Ignition/Ventilation selector switch : ignition
High-lift device selector switch : OFF
In-flight relight control : aft
Throttle lever : -Stop
-Airbrakes : in
-Combat flap lever : in
Slat/Flap lever : full forward
or in the same position as the flaps
A/B main cock switch : open (guarded)
JPT emergency regulation switch : NORM
V/UHF (red) : as required
INCIDENCE TEST SWITCH : TEST BAND + WARNING HORN
LEAD LIGHT : TEST ITS OPERATION BY REMOVING IT FROM ITS HOUSING

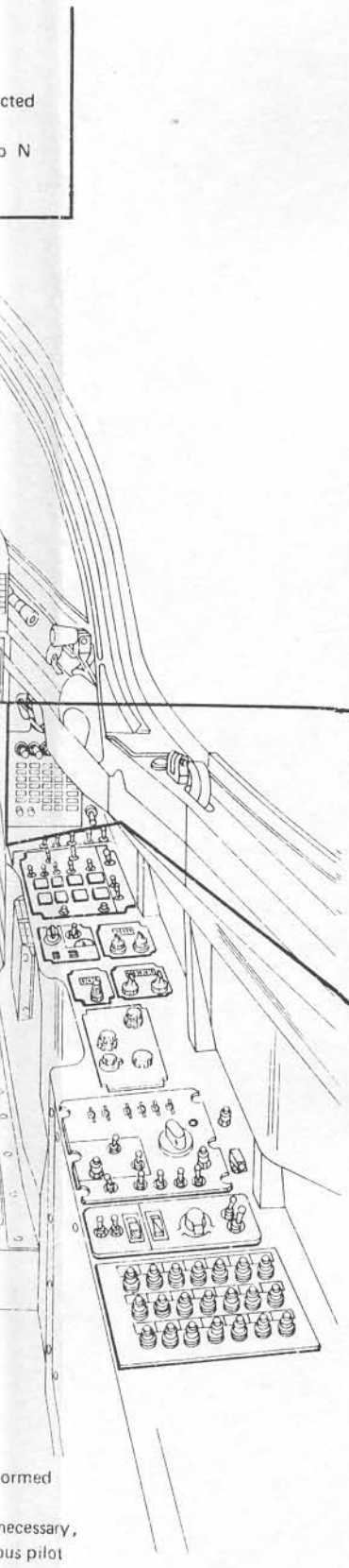
Test display unit — Off, guarded
RIMS Control Unit : off



NOTE: Heavy type denotes operations to be performed

Small type indicates that only a check is necessary, the cockpit having been secured by previous pilot and ground crew.

ACS CONT



Standby magnetic compass : heading check
Accelerometer = 1
RADAR INDICATOR SCOPE : POLAROID SCREEN ADJUSTMENT CHECK
INTENSITY AND STORAGE REDUCED
RADAR INDICATOR SCOPE CONTROL UNIT : SET
Dinghy puncturer : in position
Navigation indicator : off
Radio-altimeter : off

Fuel Controls
- Fuel remaining indicator : quantity set
- **FUEL TRANSFER SEQUENCE SELECTOR SWITCH: AS REQUIRED**
- Emergency fuel transfer switch : off
- Crossfeed switch : OFF
- **DUAL FUEL GAUGE : TESTED**
- **FEEDER TANK/FUSELAGE SELECTOR SWITCH: TO FUSELAGE THEN FEEDER TANKS**
- **FUEL TRANSFER INDICATOR : LIGHTS TESTED**

Shock cone position indicator : 1.27
SHOCK-CONE PUSHBUTTON : DEPRESSED
LIGHTS {Nose wheel steering / Limit + Warning horn} TESTED
Emergency steering switch : on (guarded)
NOSE WHEEL STEERING HIGH SENSITIVITY BUTTON : DEPRESSED
Shock-cone manual control switch : neutral
Anti-skid (SPAD) switch : on (guarded)
Hydraulic pressure selector switch : 1 SERVO 2
Radar warning control unit : OFF
Jettison buttons : guarded

Emergency U/C handle : in and folded back
ALT.1 switch : ON
ALT.2 switch : ON
Inverter selector switch : AUTO

FAILURE WARNING PANEL AND MASTER
FAILURE WARNING LIGHT + WARNING HORN : TESTED
OXYGEN WARNING HORN : TESTED
Formation light switch : as required
Navigation light switch : as required
Canopy seal valve control lever : INFLATE (forward position)

Standby horizon switch : OFF
ELECTRO-PUMP TEST
EMG HYD light is on
- -Set EL PUMP switch to ON and check that:
- EMG HYD light goes off, servo 1 pressure increases up to 170 ± 5 bar approx., the electro-pump stops.
- -Through actuation of the flight controls, drop servo 1 pressure to 145 $^{+5}_{-0}$ bar; the electro-pump restarts and if pressure is prevented from rising again for more than 8 seconds; the EP light comes on.
- -Set EL PUMP switch to OFF

WARNING HORN SWITCH : OFF
Probe heater switch : OFF
Search light switch : OFF

Armament control panel
- Sight selector switch: OFF
- Radar selector switch : OFF
- Selection pushbuttons : released
- Single scanning switch : as required
- Normal/Altitude difference selector switch : as required

Gyro system selector : OFF
Emergency gyromagnetic compass selector switch : OFF
TACAN : OFF
VOR : OFF
IFF modes checked : OFF

Air Conditioning
- Demist switch : off (aft)
- Ram air switch : off (guarded)
- Master valve control switch : OFF
- EMG COLD switch : off
- CABIN temperature control rheostat : AUTO
- EQUIP AUTO/MANUAL selector switch : AUTO

ormed
necessary,
us pilot

(R/H Console)

ACS CONTROL UNIT – OFF

FIGURE 2A – CABIN CHECK
(POST/SAAF/MOD/MIR/281, 282, 294)

TP 0018
Atlas Amendment No. 4
Sept. 1989

2, 10. 3 - CABIN CHECK

Clock : wound and set
Incidence indicator : intensity adjusted

LIGHTS { Combat flaps
Configuration indicator
U/C-not-down
Nose wheel steering
Airbrakes
Limit + Warning horn
Engine and A/B fire + Warning horn
Autopilot (if GPU connected) } **TESTED**

Residual pressure light : on
Shock-cone position indicator : < 1.27
Mach/Airspeed indicator : zero (index set)
RPM indicator : zero

A/B + «SRL» LIGHTS : TESTED
Slaved altimeter : red flag visible
JPT indicator : pointer below scale
Vertical speed indicator : zero
Jettison buttons : guarded

Canopy jettison or embrittle control : aft (safetied)
Brake chute control : forward, lever tip up, marks aligned

STANDBY LIGHT (CONDITIONING DOOR) : TESTED
Stick uncouple switch : off (guarded)
Pitch switch : «PITCH»
Yaw/Anti-slip switch : «ANTI-SLIP»
ARTHUR selector switch : «AUTO» (guarded)
U/C CONTROL LEVER : DOWN, SAFETY CLEARED

Landing light control : «OFF»
Emergency regulation switch : off (guarded)

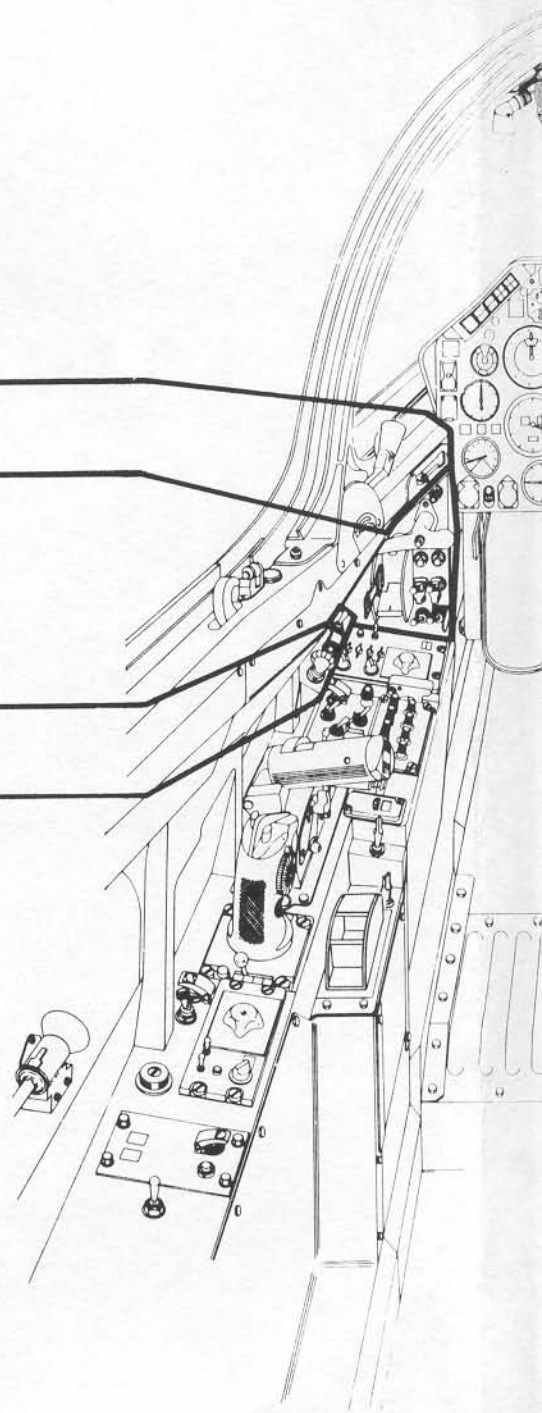
V/UHF (green) : as required
Armament master switch : off (guarded)

RADIO SELECTOR UNIT : SET
EMERGENCY REGULATION LIGHT : TESTED

LP main cock switch : closed (unguarded)
L/H and R/H LP pump switches : off
Starting pump switch : off
Ignition/Ventilation selector switch : ignition
High-lift device selector switch : «OFF»
In-flight relight control : aft
Throttle lever : - Stop
- Airbrakes : in
- Combat flap lever : in

Slat/Flap lever : full forward
or in the same position as the flaps
A/B main cock switch : open (guarded)
JPT emergency regulation switch : «NORM»
V/UHF (red) : as required
Test display unit : guarded
INCIDENCE TEST SWITCH : TEST BAND + WARNING HORN
LEAD LIGHT : TEST ITS OPERATION BY REMOVING IT FROM ITS HOUSING

Sight {
Sight came
STANDBY
Spherical i
Standby h



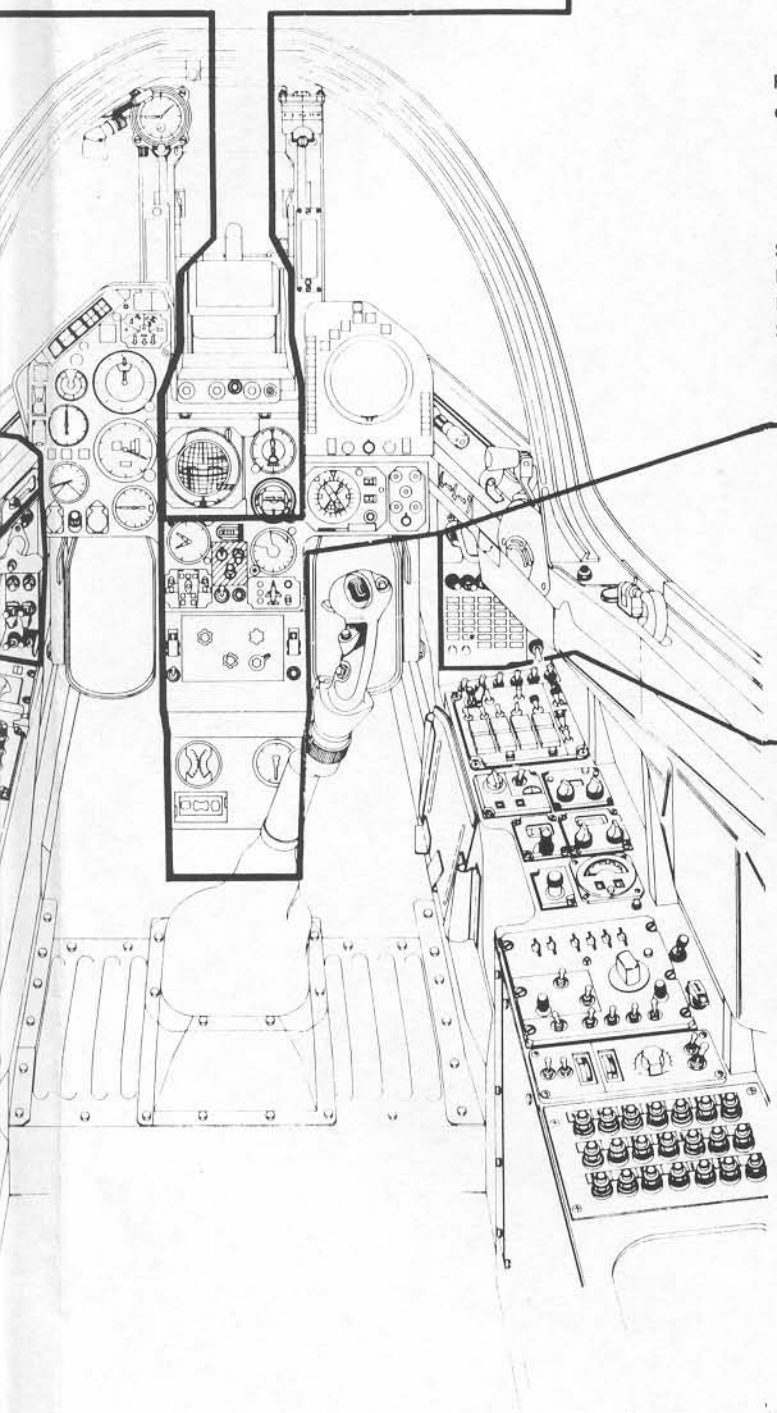
NOTE : Heavy type de

Small type ind
the cockpit ha
and ground cr

FIGURE 2 – CABIN CHECK

Sight { Lighting selector switch : «N»
Intensity selector switch : «AUTO»

Sight camera : overrun and framing rate selected
STANDBY ALTIMETER : SET
Spherical indicator : «N/P» selector switch to «N»
Standby horizon : caged (flag visible)



Standby magnetic compass : heading checked
Accelerometer = 1
RADAR INDICATOR SCOPE : POLAROID SCREEN ADJUSTMENT CHECKED
INTENSITY AND STORAGE REDUCED
RADAR INDICATOR SCOPE CONTROL UNIT : SET
Dinghy puncturer : in position
Navigation indicator : off
Radio-altimeter : off

Fuel controls {
- Fuel remaining indicator : quantity set
- **FUEL TRANSFER SEQUENCE SELECTOR SWITCH : AS REQUIRED**
- Emergency fuel transfer switch : off
- Crossfeed switch : «OFF»
- **DUAL FUEL GAUGE : TESTED**
- **FEEDER TANK/FUSELAGE SELECTOR SWITCH : TO «FUSELAGE» THEN «FEEDER TANKS»**
- **FUEL TRANSFER INDICATOR : LIGHTS TESTED**

SHOCK-CONE PUSHBUTTON : DEPRESSED
Emergency steering switch : on (guarded)
NOSE WHEEL STEERING HIGH SENSITIVITY BUTTON : DEPRESSED
Shock-cone manual control switch : neutral
Anti-skid (SPAD) switch : on (guarded)
Hydraulic pressure selector switch : «1 SERVO 2»

Emergency U/C handle : in and folded back
«ALT.1» switch : «ON»
«ALT.2» switch : «ON»
Inverter selector switch : «AUTO»

FAILURE WARNING PANEL AND MASTER
FAILURE WARNING LIGHT + WARNING HORN : TESTED
OXYGEN WARNING HORN : TESTED
Formation light switch : as required
Navigation light switch : as required
Canopy seal valve control lever : «INFLATE» (forward position)

Standby horizon switch : «OFF»
ELECTRO-PUMP TEST
EMG HYD light is on
- Set «EL PUMP» switch to «ON» and check that :
- EMG HYD light goes off, servo 1 pressure increases up to 170 ± 5 bar approx., the electro-pump stops.
- Through actuation of the flight controls, drop servo 1 pressure to 145 $^{+5}_{-0}$ bar ; the electro-pump restarts and

  if pressure is prevented from rising again for more than 8 seconds, the EP light comes on.
- Set «EL PUMP» switch to «OFF»

WARNING HORN SWITCH : «OFF»
Probe heater switch : «OFF»
BF radar detector switch : «OFF»
Search light switch : «OFF»

Armament control panel {
- Sight selector switch : «OFF»
- Radar selector switch : «OFF»
- Selection pushbuttons : released
- Single scanning switch : as required
- Normal/Altitude difference selector switch : as required

Gyro system selector : «OFF»
Emergency gyromagnetic compass selector switch : «OFF»
TACAN : «OFF»
VOR : «OFF»
IFF modes checked : «OFF»

Air conditioning {
- Demist switch : off (aft)
- Ram air switch : off (guarded)
- Master valve control switch : «OFF»
- «EMG COLD» switch : off
- «CABIN» temperature control rheostat : «AUTO»
- «EQUIP» «AUTO/MANUAL» selector switch : «AUTO»

Heavy type denotes operations to be performed.

Small type indicates that only a check is necessary, the cockpit having been secured by previous pilot and ground crew.

2,15 - STARTING - TAXIING - TAKEOFF

2,15.1 - STARTING PROCEDURE

Starting is made on the battery with :

- the canopy closed, or partially open
- the parking brake set

WHEN CLEARED BY GROUND CREW

- Open the LP main cock.
- Switch on the RH and LH LP pumps.
- Ignition/Ventilation selector : SWITCH TO OTHER PLUG (to permit alternate use of the plugs upon starting).
- Lift the starter button guard
  (check that the starting LP pump switch is effectively switched on).
- Wait for the [L P.] light to go out and immediately depress the starter button (for 1 second approx. ; never exceed 2 seconds) and simultaneously start the stopwatch.
- The oil pressure indicator light should remain on four N below 2000 rpm (24% for 9K50 engines.) If the light fails to come on, engine starting shall be discontinued
- Between 300 and 600 rpm - THROTTLE TO IDLE (engine cold, bring the throttle slightly beyond idle).
- The [B.O.V.] light is on (at night, if the illumination of the light is not visible, momentarily increase the intensity of the failure warning panel).
  In all cases, if the light does not come on, interrupt starting.
- Watch the RPM indicator and JPT indicator and check that the engine accelerates normally.
- If starting is normal, the engine should accelerate positively and attain a speed $\geq$ 2000 rpm after approximately 15 seconds. During the same period, if the JPT increases rapidly through 700°C : close the throttle.

  Exceptionally, JPT $\sim$ 850°C is permissible for a period $\leq$ 3 seconds.
- The [HYD.1], [HYD.2] and [OIL] lights go out.
- The [B.O.V.] light is out at 2200 rpm.
- The [ALT.1] and [ALT.2] lights go out between 2600 and 2800 rpm depending on the load.
- Idle rpm stabilizes close to 2900.
  (If the engine is cold, the speed is about 2600 to 3200 rpm ; this phenomenon should disappear as soon as the engine is warmed up).
- Set the inverter control to «RESET» ; the [EMG~] light goes out.

NOTE : Do not leave the LP main cock open for more than 15 seconds before starting the LP or starting pumps.

REMARK :

In case of operation of the slotted slat comparator (configuration indicator red light and [S / F] light on)

- Set the high-lift device selector switch to «EMG RETR».

STARTING INCIDENTS See para. 4,25, SECTION 4.

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2,15 - STARTING - TAXIING - TAKEOFF

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- Between 300 and 600 rpm - THROTTLE TO IDLE (engine cold, bring the throttle slightly beyond idle).
- The [B.O.V.] light is on (at night, if the illumination of the light is not visible, momentarily increase the intensity of the failure warning panel).
  In all cases, if the light does not come on, interrupt starting.
- Watch the RPM indicator and JPT indicator and check that the engine accelerates normally.
- The [OIL] light should remain on when $N < 2000$ rpm ; otherwise, interrupt starting.
- During acceleration, the [L P.] light may come on until the alternators cut in.
- If starting is normal, the engine should accelerate positively and attain a speed $\geqslant 2000$ rpm after approximately 15 seconds. During the same period, if the JPT increases rapidly through 700° C : close the throttle.
  Exceptionally, JPT $\sim 850°$ C is permissible for a period $\leqslant 3$ seconds.
- The [HYD.1], [HYD.2] and [OIL] lights go out.
- The [B.O.V.] light goes out between 750 and 2200 rpm.
- The [ALT.1] and [ALT.2] lights go out between 2600 and 2800 rpm depending on the load.
- Idle rpm stabilizes close to 2900.
  (If the engine is cold, the speed is about 2600 to 3200 rpm ; this phenomenon should disappear as soon as the engine is warmed up).
- Set the inverter control to «RESET» ; the [EMG~] light goes out.

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2,15 - STARTING - TAXIING - TAKEOFF

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- the parking brake set

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- Ignition/Ventilation selector : SWITCH TO OTHER PLUG (to permit alternate use of the plugs upon starting).
- Lift the starter button guard
  (check that the starting LP pump switch is effectively switched on).
- Wait for the [L P.] light to go out and immediately depress the starter button (for 1 second approx. ; never exceed 2 seconds) and simultaneously start the stopwatch.
- Between 300 and 600 rpm - THROTTLE TO IDLE (engine cold, bring the throttle slightly beyond idle).
- Watch the RPM indicator and JPT indicator and check that the engine accelerates normally.
- The [OIL] light should remain on when $N < 2000$ rpm ; otherwise, interrupt starting.
- During acceleration, the [L P.] light may come on until the alternators cut in.
- If starting is normal, the engine should accelerate positively and attain a speed $\geqslant 2000$ rpm after approximately 15 seconds. During the same period, if the JPT increases rapidly through 700° C : close the throttle.

  Exceptionally, JPT $\sim 850°$ C is permissible for a period $\leqslant 3$ seconds.
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- The [ALT.1] and [ALT.2] lights go out between 2600 and 2800 rpm depending on the load.
- Idle rpm stabilizes close to 2900.
  (If the engine is cold, the speed is about 2600 to 3200 rpm ; this phenomenon should disappear as soon as the engine is warmed up).
- Set the inverter control to «RESET» ; the [EMG~] light goes out.

NOTE : Do not leave the LP main cock open for more than 15 seconds before starting the LP or starting pumps.

REMARK :

In case of operation of the slotted slat comparator (configuration indicator red light and [S/F] light on)

- Set the high-lift device selector switch to «EMG RETR».

STARTING INCIDENTS See para. 4,25, SECTION 4.

2,15.2 - AFTER START CHECKS

From right to left

- Master valve control switch	«ON»	
- Temperature control rheostat	«AUTO», 12 o'clock	
- IFF	«SBY»	
- VOR/ILS	«ON»	
- Omnibearing selector box	VOR/ILS or TAC	
- TACAN	«REC», station selected (10 minutes max. on ground)	
- Heading control box		
. gyro reference system selector	«GM»	
. emergency gyromagnetic compass selector	«ON»	
- Armament control panel		
. radar	«STBY»	
. sight	«ON»	
- Standby horizon switch	«ON»	
- Electric pump switch	..... EMG.HYD	goes out
- Warning horn switch		
- Probe heat switch	..... PITOT	goes out
- Radar detector switch		
- Searchlight switch	as required	

- Navigation indicator	«VT»	«N» or «VECT ADD»
- Standby horizon	uncaged	
- Radar detector warning panel	tested	tone adjusted
- Shock-cone pushbutton	depressed	
- Nose wheel steering	high sensitivity selected	
- Servos	reset if necessary by action on button	
- V/UHF (red)	on	frequency selected
- V/UHF (green)	on	frequency selected

2,15.3 - PRE-TAXIING CHECKS

T - Trims . . . . . tested then set to neutral

A - Airbrakes : pilot's signal, jaw type hand movements . . . . . airbrakes extended and locked

F - Flaps : after ground crew signal

- Slat/Flap lever	full aft	slats full down
- High-lift device selector switch	«NORMAL» check	flaps full down
- Combat flap lever	retracted	«CBT.F» light out

Ground crew moves aft and checks :

- Flaps
- Airbrakes
- Yaw damper . . . . . ground crew exerts a few lateral thrusts on aft fuselage section and checks that control surface reacts by short oscillations

F - Fuel

Fuel transfer sequence selector switch . . . . as required

Emergency fuel transfer switch . . . . . down position

Crossfeed switch . . . . . «OFF»

Fuel gages . . . . . fuel remaining indicator operates normally - fuselage and feeder tank quantities checked

L P. | L/H L P | R/H L P | 500 L. lights. . out

I - RADAR . . . . . set

- Sight . . . . . set
- Hydraulic pressures . . . . . normal
- Failure warning panel . . . . . lights out

O - Oxygen . . . . . quantity - pointer in green range

- Seat/Aircraft coupling . . . . . checked
- Blinker . . . . . operation checked

H - Harness . . . . . correctly adjusted and locked

C - Canopy . . . . . locked (canopy control in correct position)

Ground crew returns to the front ; the pilot :

- retracts the airbrakes
- tests the nose wheel steering system through the rudder pedals and checks the control stick for fuff travel.

2,15.4 - TAXIING

- Slaved altimeter . . . . . set
- Standby altimeter . . . . . set

1- STARTING AIRCRAFT ROLLING

The canopy can be partially opened for taxiing, but it must be placed in this position with the aircraft stationary.

- Release the parking brake . . . . . check handle in full forward position («BRAKES» light out)
- Advance the throttle (6000 rpm)
- Start rolling, then apply the brakes : the ground crew checks the pitch damper.

The aircraft is steered with the rudder pedals WITHOUT THE ASSISTANCE OF THE BRAKES.

NOTE 1: It is recommended to avoid engine power settings between 5500 and 6000 rpm during taxiing (alternator gear change).

NOTE 2: Do not exceed a speed of 20 kt when taxiing in a straight line (heavy aircraft in particular). Turn slowly and obey these instructions even when the weather is hot and taxiing distances are long.

2- DURING TAXIING

- IFF. . . . . self-test with or without ground receiver (TOWER/RADAR)
- Adjust radar and sight . . . . . as required
- Standby horizon . . . . . miniature airplane adjusted
- Navigation indicator. . . . . tested

3- BEFORE LINE-UP

- Lower the helmet visor
- IFF. . . . . normal
- TACAN. . . . . T/R, tested
- Radar . . . . . transmission
- Radio-altimeter. . . . . «ON» (tested, altitude selected)
- Jettison buttons . . . . . unguarded (if carrying stores)
- Emergency regulation light . . . . . out

BEFORE THE FIRST FLIGHT OF THE DAY, PERFORM THE FOLLOWING EMERGENCY REGULATION TEST :

- Throttle. . . . . idle. . . . . wait for engine speed to stabilize at 2900 ± 100 rpm
- Emergency regulation switch. . . . . on
- Emergency regulation light . . . . . on
- Increase engine rpm by blipping the emergency regulation control lever

As soon as engine rpm increase is noted :

- Emergency regulation switch. . . . . off
- Emergency regulation light . . . . . out

Check that 2900 ± 100 rpm is restored .

NOTE : If the engine has to be shut down after this test, limit the duration of the latter to 10 seconds. If 10 seconds are exceeded, set an engine power of about 7200 rpm for about 2 minutes using the throttle, which enables the bearing 1 emergency lubricating oil to be recovered.

CAUTION

THIS DAILY TEST IS TO BE PERFORMED ONLY ON AIRCRAFT WHOSE ENGINE DOES NOT INCORPORATE MODIFICATION 309.
FOR POST-MOD. 309 ENGINES, THE EMERGENCY REGULATION TEST IS PERFORMED WEEKLY (SEE PARA. 2,40).

4- AFTER LINE-UP

- Headings . . . . . checked

C - Canopy . . . . . closed and locked CAB.P light out

H - Harness . . . . . adjusted and locked

A - (Not applicable)

F - Slats and flaps. . . . . as required

L - Failure warning panel lights. . . . . out

- Fuel transfer indicator lights . . . . . out (check made with some power)

P - Takeoff power . . . . . set

C - Flight controls . . . . . free

4- AFTER LINE-UP

	- Heading selector . . . «NAV 1» or «HDG 1»	headings checked
C	- Canopy	closed and locked CAB.P light out
H	- Harness	adjusted and locked
A	- (Not applicable)	
F	- Slats and flaps.	as required
L	- Failure warning panel lights.	out
	- Fuel transfer indicator lights	out (check made with some power)
	- Probe heat switch	«ON» PITOT goes out
P	- Takeoff power	set
C	- Flight controls	free

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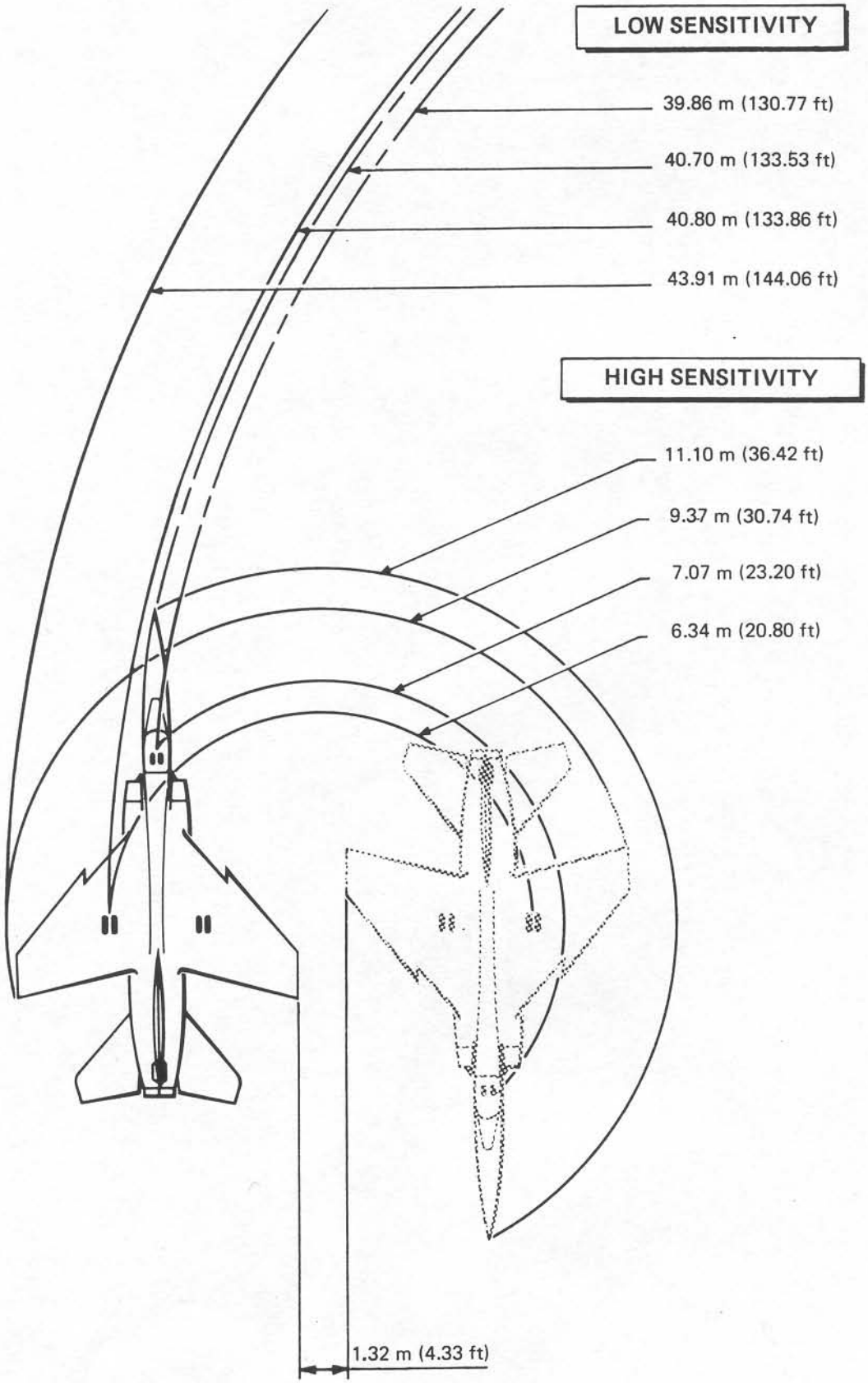


FIGURE 1 – TURNING RADII (Without using brakes)

2,15.5 - TAKEOFF

1 - DEFINITION OF SPEEDS ASSOCIATED WITH TAKEOFF

V_{AS} (Accelerate-Stop Speed) : This is the speed below which it is always possible to abort takeoff without engaging the arresting barrier, using or not (as applicable) the emergency energy ; with or without the brake chute.

Two V_{AS} values should be considered :

- V_{AS_1} : Speed computed in relation to the use of the emergency energy without the brake chute
- V_{AS_2} : Speed computed in relation to the use of the emergency energy with the brake chute

V_R (Rotation Speed) : This is the speed at which the aircraft is rotated (with main wheels on ground) for lift-off.

V_{LOF} : This is the speed at which the main wheels leave the ground.

V_{ES} (Emergency Stop Speed) : This is the speed above which, even when using the emergency braking energy (with brake chute), the aircraft can no longer be stopped on the runway (equipped with an arresting barrier). The barrier will be engaged at speeds beyond its capabilities.

These speeds are determined by referring to the plates in Book 3 (except for V_{ES}).

2 - TAKEOFF PROCEDURE - CLEAN AIRCRAFT OR WITH MATRA 550 MISSILES

- AB : minimum selected on brakes by using the SRL system
  When the AB is ignited, check rpm and JPT
- Release the brakes ; after rolling a few yards, select full AB power for the AB effect to be felt
- Hold the aircraft on the centerline with the nose wheel steering system, avoiding excessive action on the rudder pedals
- Leave the pitch control in neutral position
- TIME CHECK at 100 kt (1 second per ton)
- At 120 kt (rotation speed), establish the takeoff attitude (12° approximately)
- The high-sensitivity button pops out
- The aircraft becomes airborne at about 150 kt
- Retract the U/C (it is not necessary to brake the wheels)
- Retract the flaps at 200 kt while increasing the attitude
- At 300 kt - Jettison button guard down
  . AB off
  . Oxygen at normal

3 - TAKEOFF PROCEDURE WITH STORES

The takeoff procedure is the same as that in clean aircraft configuration.

Refer to Book 3 for computing the parameters.

- At 300 kt, replace the guards on the jettison buttons.

2,15.6 - USE OF AB

1- ON THE GROUND

- Throttle directly to min. AB.

The SRL system ignites the AB.
Three seconds after 8100 rpm is reached, the red «INJ» light comes on ; a few seconds later, the «INJ» light goes out.
The green «ON» light comes on : the AB operates.
The engine parameters stabilize.

2- IN FLIGHT

- Throttle directly from any position in the dry quadrant to any position in the AB quadrant.

If, during ignition, engine rpm falls below 7600, retard the throttle to military thrust and try again as soon as engine rpm is stabilized.

WARNING

IF THE «INJ» LIGHT REMAINS ON FOR MORE THAN 10 SECONDS, SHUT OFF THE AB.

CAUTION

«SRL» LIGHT ON, or «ON» LIGHT ON IN DRY QUADRANT	TO IGNITE THE AB, APPLY THE INSTRUCTIONS IN PARA. 3

3- IGNITION WITHOUT SRL SYSTEM

To ignite the AB :
- check JPT $\geqslant 600^{\circ}C$
- select min. AB only

To increase the AB thrust, wait for the following :
«INJ» light out and «ON» light continuously on
If «INJ» light does not go out after 10 seconds, shut off the AB

In case of firing with firing fuel dipper at max. AB :
- bring the throttle back to min. AB until the AB is completely relit :
«ON» light continuously on.

2,25 - NORMAL FLIGHT

Missions are planned with the assistance of the performance curves given in Book 3.

2,25.1 - CLIMBS - CEILING - CRUISE - COMBAT

See Book 3.
The following values will be kept in mind for normal flight.

1 - CONSTANT IAS AND MACH NUMBER CLIMBS

The subsonic climb schedules are :

- clean configuration	: military thrust	IAS = 470 kt	and M = 0.92
	maximum thrust	IAS = 500 kt	and M = 0.95
- two RP 35 pylon tank configuration	: military thrust	IAS = 422 kt	and M = 0.84
	maximum thrust	IAS = 475 kt	and M = 0.92

The supersonic climb schedule is :

- climb according to one of the subsonic schedules up to 30,000 ft
- accelerate up to 650 kt in level flight
- climb at constant IAS of 650 kt up to M = 1.8
- maintain M = 1.8 up to desired altitude.

2 - CEILING

Limited to 50,000 ft for safety reasons.

3 - CRUISE

The navigation parameters (altitude and IAS) and the loading configuration parameters (external stores), which are retained according to the mission, greatly affect the flight time and fuel consumption.

4 - COMBAT

(1) Auto slats only

The high-lift device selector switch is in the «NORMAL» position.

(2) Combat slats and flaps

Normally, the combat flaps are operated manually ; the high-lift device selector switch is in the «NORMAL» position and the combat flap lever is extended or retracted within the combat flap envelope (300 kt, M 0.75) each time the pilot needs the flaps or not.

Preselection out of the envelope should be used only when the maneuvers are going to bring the aircraft back into the envelope. The combat flaps should in no case be preselected beyond M = 0.9.

When a maneuver leads to go momentarily out of the envelope, the combat flap lever may be kept out ; the flaps will be retracted and extended by the interlocks.

When a maneuver leads to go definitively out of the envelope, in particular if the Mach number is to exceed 0.9, the combat flap lever must be retracted.

2,25.2 - ACCELERATION

BEFORE ANY SUPERSONIC ACCELERATION, CHECK :

- shock-cone pushbutton : depressed
- high-lift device selector switch : «OFF».

To reach the maximum Mach number in the shortest time, the procedure is as follows :

The AB overboost system automatically cuts in as soon as the altitude exceeds 27,500 ft. No indication is given to the pilot as concerns AB overboost system operation ; in particular, the JPT reading does not change.

- accelerate at Hp = 30,000 ft until IAS = 650 kt, i.e., M $\sim$ 1.65
- climb at constant IAS of 650 kt up to 36,000 ft and continue the acceleration in level flight.

At Mach 1.4, check that the engine overspeed system has cut in : 8900 rpm and 25 to 30°C JPT drop.

For a given temperature and weight, the acceleration time increases with the altitude.

CAUTION

EVERY 10 MACH POINTS, CHECK CONCURRENCE BETWEEN AIRCRAFT MACHMETER AND SHOCK-CONE POSITION INDICATOR FROM M = 1.27 ONWARDS.
THE ACCELERATION/DECELERATION TOLERANCE IS 0.10 M.

REMARK :

For deceleration :

- AB shutoff is authorized throughout the envelope
- reduction of engine rpm is authorized only at M < 1.4.

2,25.3 - HIGH-SPEED FLYING

- Set the high-lift device selector switch to «OFF».

At M > 1, roll control effectiveness decreases above IAS = 600 kt.

When passing through the transonic range during a turn, there is a slight turn tightening tendency, specially if the airbrakes are extended (i must be limited to $\leqslant 15^{\circ}$).
For supersonic dive, see para. 3,10, SECTION 3.

CAUTION

AT Hp < 30,000 ft, PITCH CONTROL EFFECTIVENESS MAY CAUSE THE LIMIT LOAD FACTOR TO BE EXCEEDED.

2,25.4 - ACROBATICS AND INVERTED FLIGHT

1- ACROBATICS

Starting at an altitude of 5000 ft :

- Loop
  Military thrust : entry IAS = 450 kt
  accelerate to 4 g's on entry then $i = 13^{\circ}$ while climbing
  $\Delta H \sim 10{,}000$ ft inverted IAS $\sim$ 200 kt

  Max. AB : entry IAS = 360 kt
  $\Delta H \sim 7000$ ft inverted IAS $\sim$ 200 kt

- Slow roll : IAS = 400 kt

- Fast roll : (with roll control only)
  two successive rolls maximum
  Accelerate to 450 kt < IAS < 550 kt with M < 0.9

- Minimum time turn : IAS = 300 kt $i = 17^{\circ}$ max. AB $\sim$ 4 g's

NOTE : Slat actuation only has a small influence on the aircraft behavior in pitch ; the auto slats appreciably improve the flight characteristics. For acrobatics, the high-lift device selector switch will therefore be placed in the «NORMAL» position to provide for automatic slat operation.
Flap extension results in a lift gain of about 25 % at maneuvering limit ; the lift loss is equivalent upon flap retraction.

CAUTION

FOR LOW ALTITUDE ACROBATICS, SELECT THE COMBAT HIGH-LIFT DEVICES PROHIBITED POSITION (COMBAT FLAP LEVER RETRACTED).

The above instruction is intended to prevent flap retraction at an inconvenient time, e.g., pullout at low altitude.

2- STABILIZED INVERTED FLIGHT

Stabilized inverted flight is limited to 15 seconds (capacity of negative-G flight accumulator).
Engine rpm drop is normal.
AB ignition is prohibited.

2, 25. 5 - FORMATION FLYING

Hp > 30, 000 ft : slow engine response.

Day-time close formation flying : see the figure below for alignment.

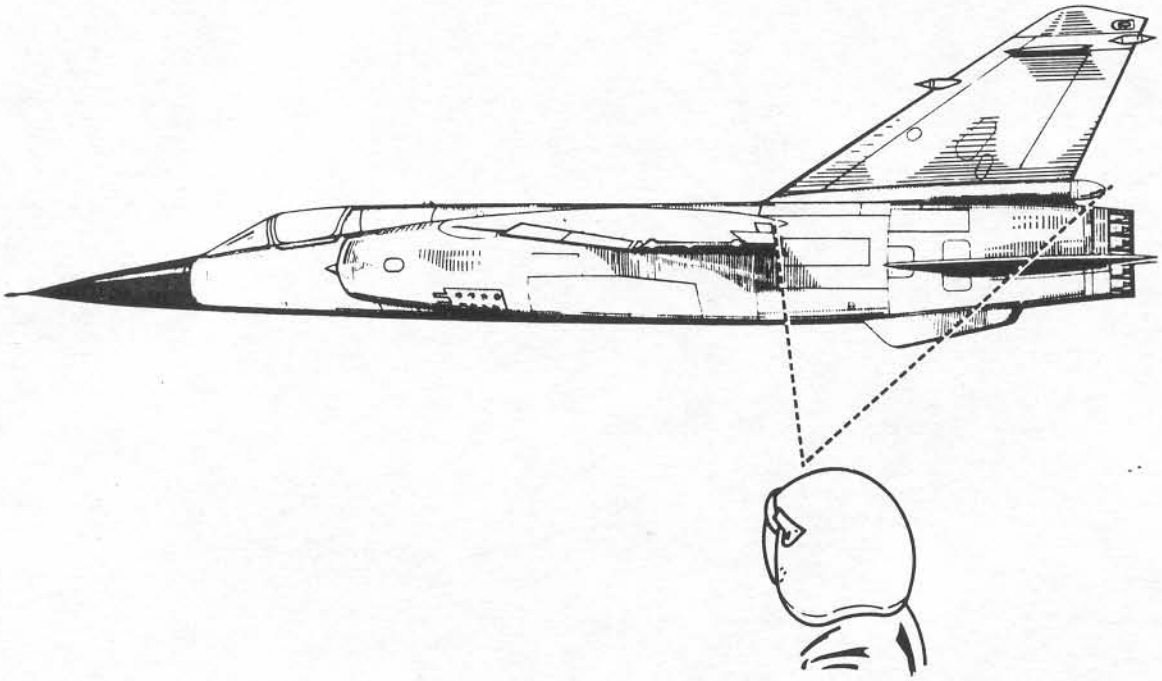


FIGURE 1 - DAY-TIME CLOSE FORMATION FLYING

2, 25. 6 - NIGHT FLYING

- testing the search light is not possible on the ground.
- test the flying aids : "DAY/NIGHT" selector switch on "DAY".
- test the navigation and formation lights after the alternators have cut in.

Night-time close formation flying : see the figure below for alignment.

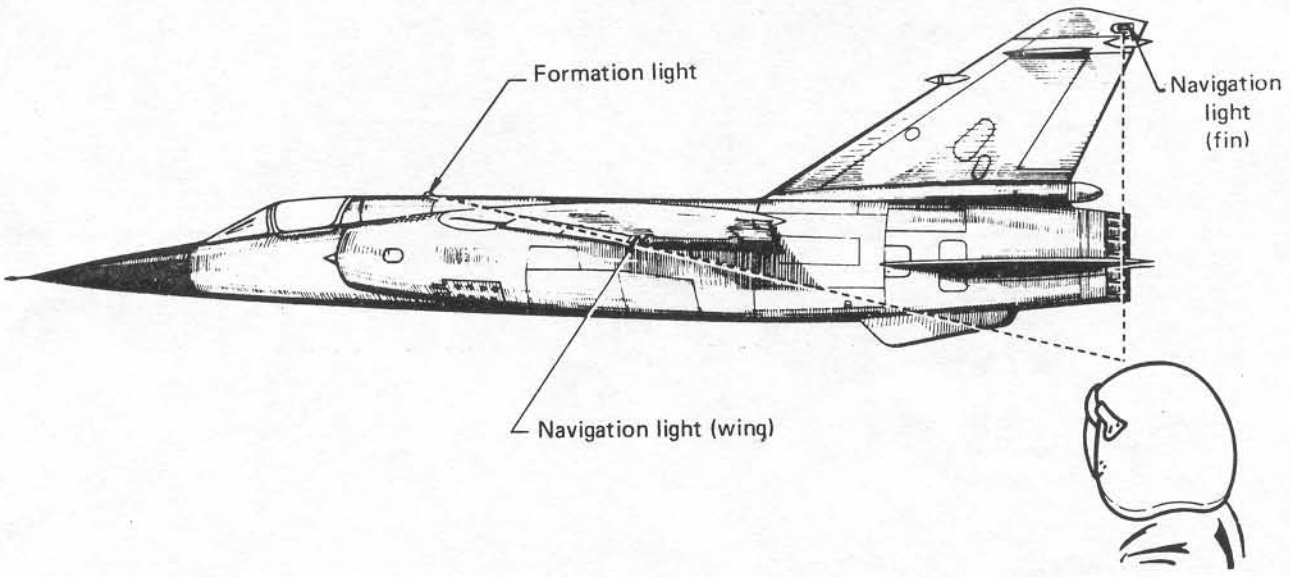


FIGURE 2 - NIGHT-TIME CLOSE FORMATION FLYING

2,25.7 - DESCENTS

Upon initiation of the descent, select COMBAT HIGH-LIFT DEVICES prohibited (combat flap lever retracted).

1 - ECONOMICAL DESCENT

RPM = 6500
Airbrakes : retracted
IAS = 300 kt
Demist switch : on

This descent gives approximately 1.5 NM flown and 2 liters consumed per 1000 ft.

2 - OPERATIONAL DESCENT

RPM ∿ 6500
Establish - 10° flight-path slope
Maintain M = 0.92
Then IAS = 450 kt
Demist switch : on

This descent gives approximately 1 NM flown per 1000 ft.

3 - FAST DESCENT

RPM = 6500
Airbrakes : extended
- 20° attitude
Demist switch : on

CAUTION

IF DEMISTING IS NOT SUFFICIENT :
- SET THE TEMPERATURE CONTROL RHEOSTAT TO «AUTO» AND FULL HOT.

4 - LETDOWN

RPM = 6500
Airbrakes : extended
IAS = 300 kt
Demist switch : on

This letdown gives approximately 1 NM flown and 2 liters consumed per 1000 ft.
The flight-path slope is - 10°. The $\overrightarrow{APP}$ display is :

NOTE : If the rate of descent has to be reduced, retract the airbrakes, maintain 300 kt IAS and 6500 rpm.
The flight-path slope is - 5° ; the $\overrightarrow{APP}$ display is :

CAUTION

IN A DESCENT, AT STABILIZED ENGINE RPM, IT IS PROHIBITED TO SET AN ENGINE RPM LOWER THAN 6500 (77 %) AT ALTITUDES LOWER THAN 10,500 m (35,000 ft).

2,25.8 - PATTERNS

1 - BREAK : 350 kt IAS

Throttle back to ⩾ 6500 rpm
Airbrakes. . . . . as required
U/C up brake test . . . . . successively depress then release each pedal ; the «BRAKES» light should come on upon each brake application.

1 - DOWNWIND LEG CHECKS

Hydraulic pressures	checked
High-lift device selector switch	"NORMAL"
Airbrakes	retracted
Undercarriage	down and locked
Flaps	full down
Fuel	crossfeed cock open and remaining fuel checked
Harness	adjusted and locked, seat adjusted
Sight	$\overrightarrow{V}$
Anti-skid system	tested (residual pressure light should stay out)
Nose wheel steering	nose wheel steering light out
Landing light	on

2 - PATTERNS : See corresponding diagrams.

USE OF INCIDENCE INDICATOR

In straight flight, an aircraft always stalls at the same incidence, regardless of the weight (the speeds vary according to the weight).

On the downwind leg after the break, keep engine rpm low (RPM ~ 6500) in order to reduce airspeed. Place the aircraft in landing configuration and allow the incidence to increase up to 10° and note the corresponding airspeed ; increase engine rpm to maintain this airspeed.

In the final turn, maintain this airspeed by adjusting the engine rpm, and the incidence indicator serves for monitoring (i averages 12 - 13°, green light on).

Check the approach incidence again on final ; in turbulent atmosphere, it is easier to chase the speed rather than the incidence (maintain IAS $\geqslant$ 150 kt).

CAUTION

ON SHORT FINAL, DO NOT REDUCE ENGINE RPM BELOW 7000 SO AS TO MAINTAIN A GOOD ENGINE RESPONSE (Exhaust nozzle flaps closed).

Relationship between i and IAS at n = 1 versus weight		Incidence Readings	IAS versus weight (*) 8700 kg	IAS versus weight (**) 11,000 kg	IAS versus weight (***) ± 100 kg
	BLUE	8			
		9	156	177	
Maximum L/D ratio (all down)		9.5			
Optimum (all down)	GREEN	10	151	172	
		11	146	167	
Watch engine rpm		12	141	162	
		12.5			
Touchdown	YELLOW	13	136	157	± 0.85
		14			
		15			
		15.5			
Keel limits	RED	16			
Limit		17	117	138	
		22			

(*) 8700 kg = without external stores and 1000 litres remaining
= with pylon tanks empty and 500 litres remaining

(**) 11,000 kg = wing tanks empty (maximum permissible landing weight)

(***) ± 100 kg = ± 125 litres

2,25.9 - LANDING

Velocity vector on runway threshold ; the pilot should check the compromise between angle of attack, glide slope and engine rpm.
The angle of attack should be between 9° and 11°.
The glide slope should be 2.5° ± 1°.
The engine rpm should be 7300 ± 300.

CAUTION

AN EXCESSIVE GLIDE SLOPE WITH POWER REDUCED WILL RESULT IN A LATE FLAREOUT AND IN LIMIT USE OF THE UNDERCARRIAGE.

- When reaching the overrun, pull out of glide slope by letting angle of attack increase from 10° to about 13°.
- Reduce engine rpm to 7000 when touchdown after the barrier is assured.

After touchdown : i ∿ 13°

- Fully close the throttle.
  The nose wheel steering system is available in the low sensitivity mode as soon as the nose wheels touch the ground.
  The high sensitivity mode can be used, as required, by depressing the button.

USE OF BRAKES AND BRAKE CHUTE
TYPES OF BRAKING

AERODYNAMIC BRAKING

It is advantageous to use aerodynamic braking by holding the nose high down to 120 kt ; i ∿ 13°.
Aerodynamic braking becomes negligible below 100 kt.
In any case, the nose wheels touch down before 90 kt.

NOTE : Though it is advantageous to use aerodynamic braking down to 120 kt, it should be kept in mind that aircraft braking, with the antiskid system operating, is really efficient only when the nose wheels have touched down.
As a matter of fact, when the nose wheels are off the ground, the aircraft speed gradually decreasing with respect to the antiskid system instruction speed, the value of wheel skidding increases and braking efficiency is proportionally reduced. The brakes will then seem to be inefficient (and the pilot will have a tendency to switch the antiskid system off).
To recover efficient braking, it is therefore necessary to lower the nose wheels to the ground when the aerodynamic effect becomes ineffective.

This technique is to be applied specially on wet runway.

MECHANICAL BRAKING

This is the basic braking system of the aircraft ; it is designed to absorb the energy corresponding to the aircraft deceleration.
Braking energy is defined by a weight and a braking initiation speed. There is a normal energy which provides for a normal service life ; beyond this limit, the brakes are damaged up to a value (emergency energy) corresponding to the destruction of the brakes once the aircraft is stopped.

BRAKE CHUTE

By participating in braking, the brake chute absorbs part of the energy. The higher the speed, the greater its effectiveness. Therefore, the brake chute permits the brakes to be applied at higher speeds for a given weight and/or landings to be made at higher weights.
It also reduces the landing distance.

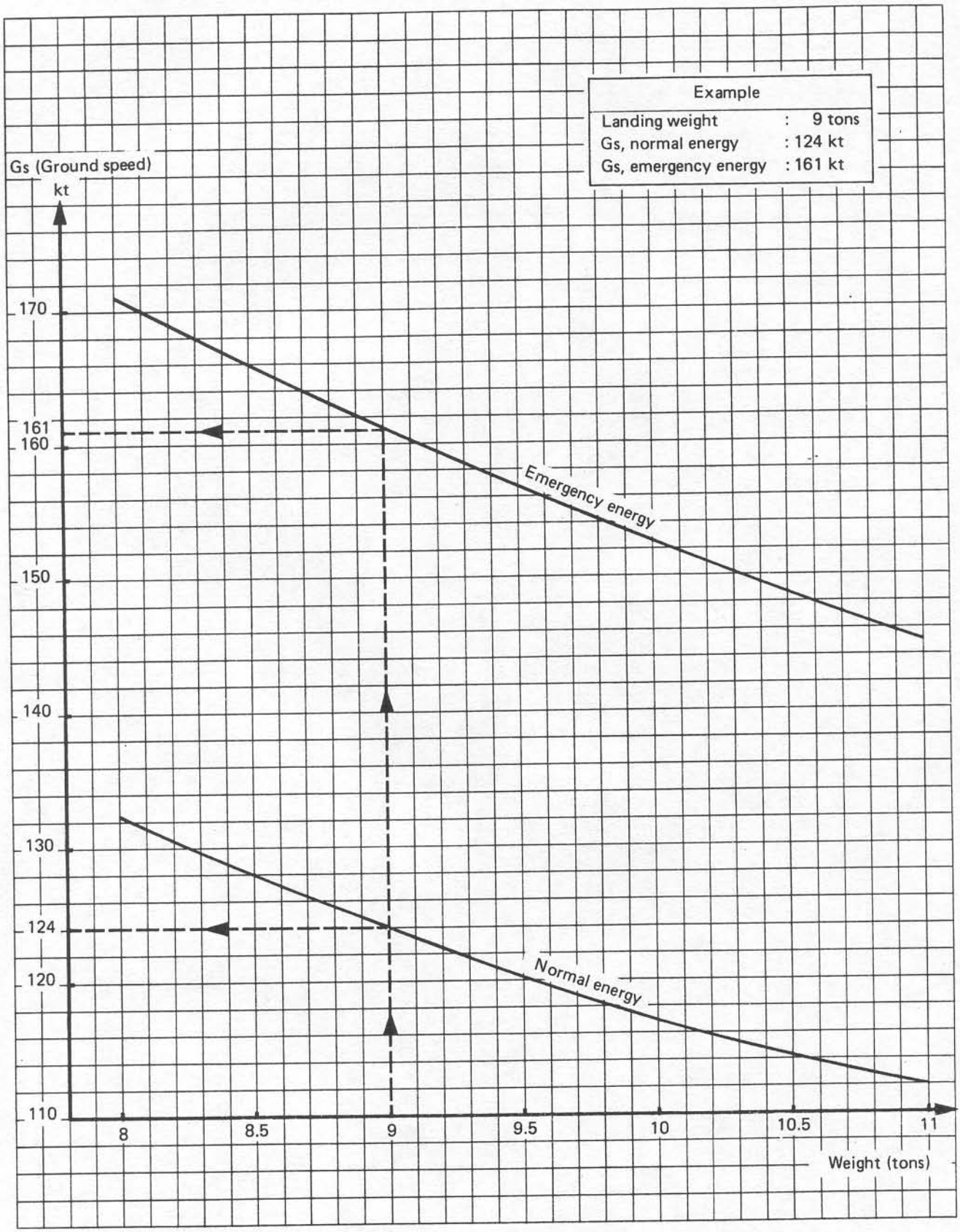


FIGURE 3 – BRAKING ENERGIES WITHOUT USING BRAKE CHUTE

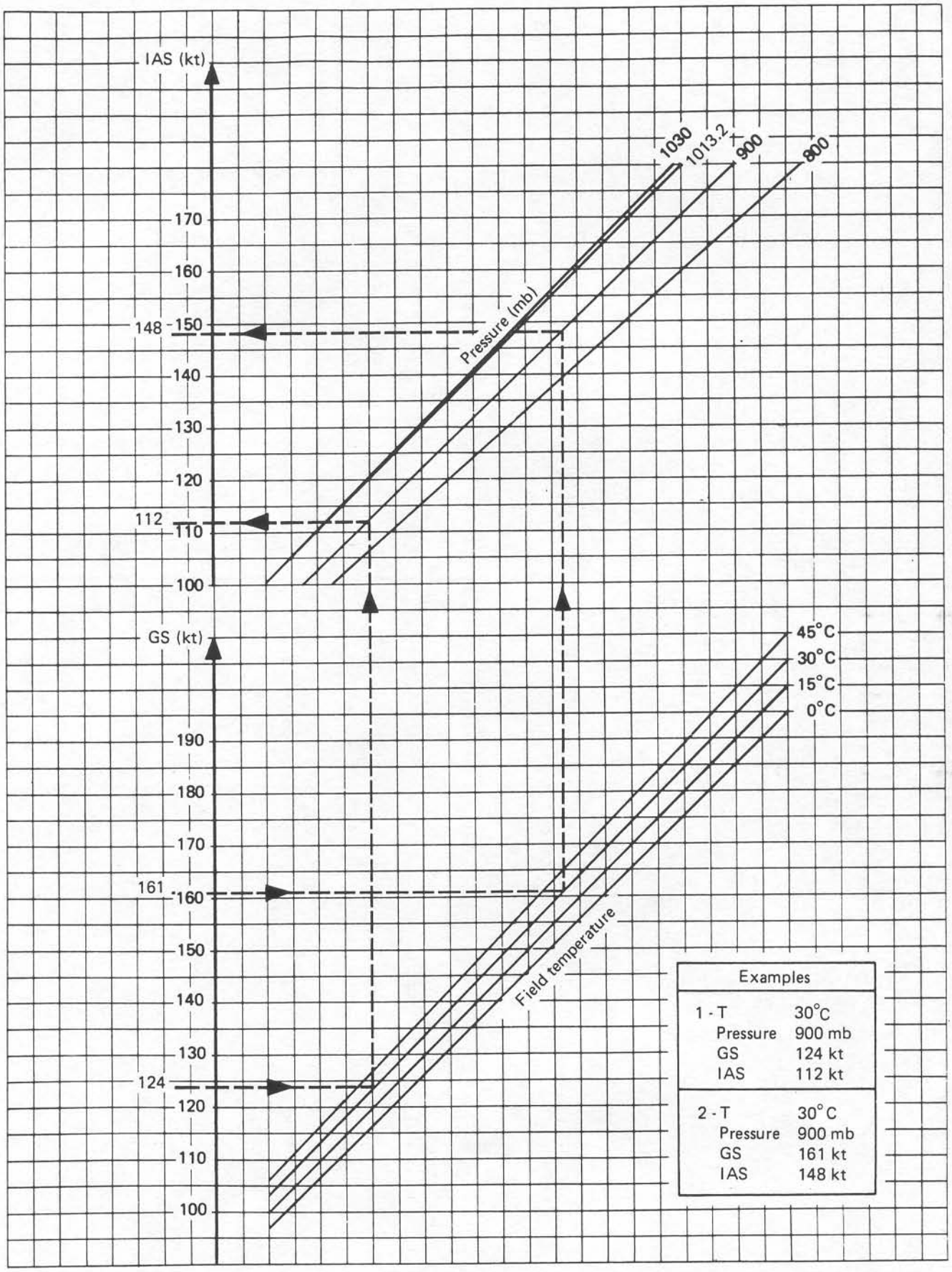


FIGURE 4 – GROUND SPEED/INDICATED AIRSPEED RELATIONSHIP

BRAKING TECHNIQUE

Braking the aircraft consists in knowing how to determine the right combination of the energy absorbing means to be used to obtain the desired type of stop according to weather conditions, aircraft weight, touchdown speed, runway condition and field elevation.

Therefore, the pilot should :

- know aircraft weight, runway condition, and ground temperature, pressure and wind conditions.
- observe the approach speeds corresponding to the aircraft configuration so as to touchdown at the best speed at the entry of the runway.
- after touchdown, throttle back and hold the nose high until the brakes are applied.
- if it is planned to use the brake chute, deploy it immediately after touchdown.
- at the braking IAS, apply the brakes ; braking intensity will be adapted to the desired stop distance.

It is reminded that the anti-skid (SPAD) system permits, in normal operation, the brake pedals to be kept fully depressed until the aircraft is stopped (minimum braking distance).

To deploy the brake chute, actuate the control rapidly and bring it fully aft.
Drop the brake chute while rolling straight on the edge of the runway by pushing the control fully forward.

CAUTION

IF TURNS ARE MADE WITH THE BRAKE CHUTE OUT, IT COLLAPSES AND THERE IS A RISK OF BURNING THE STRAPS OR OF GETTING THEM CAUGHT IN THE EXHAUST NOZZLE FLAPS ; JETTISONING THEN BECOMES VERY DIFFICULT, IF NOT IMPOSSIBLE.
THE MAXIMUM OPENING IAS IS 210 KT.
IMMEDIATE JETTISONING IS POSSIBLE.

2,25.10 - GO-AROUND

- select full power dry
- establish 12° attitude
- if necessary, select A/B.

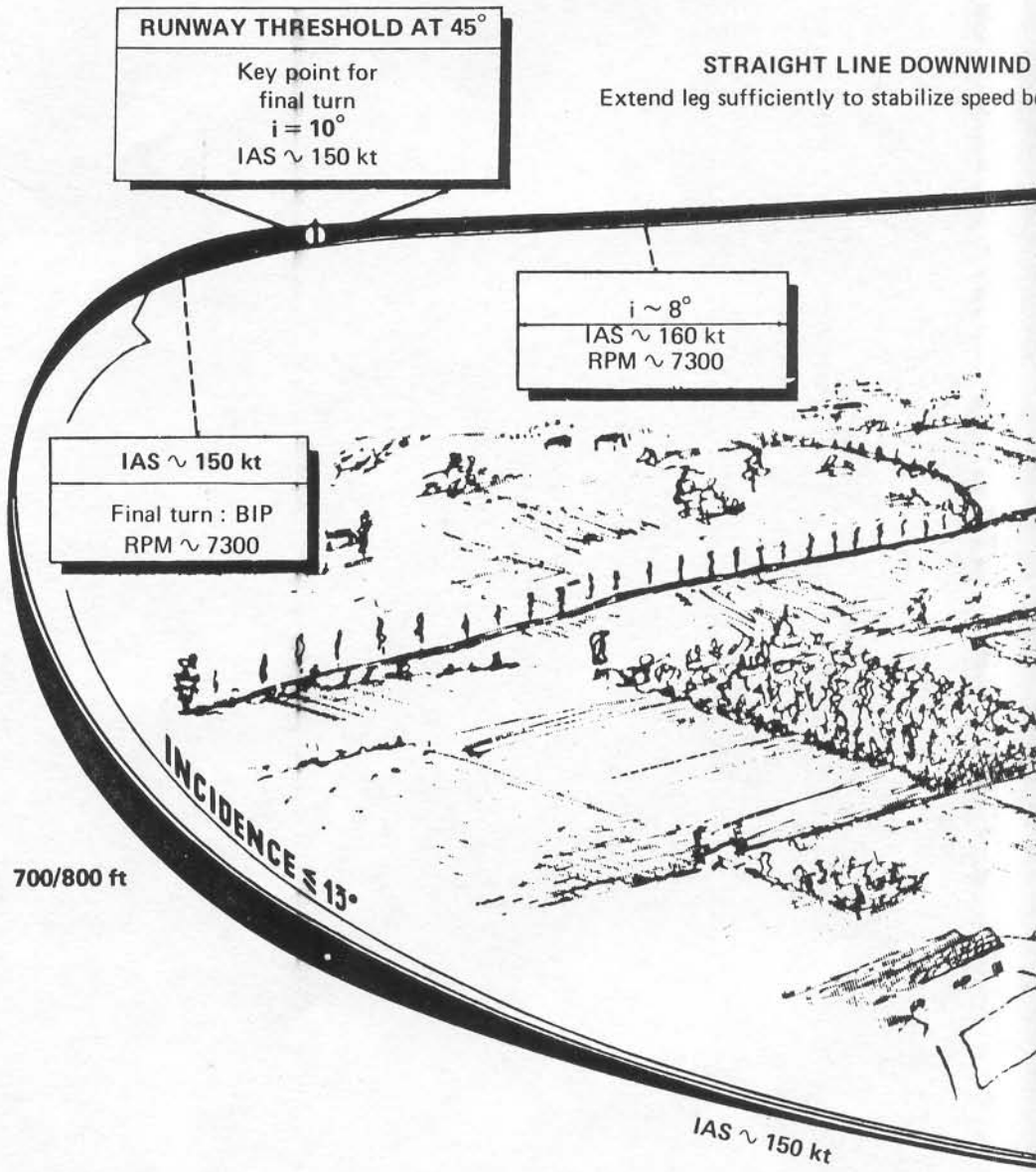
CAUTION

ENGINE RESPONSE IS NOT IMMEDIATE, ESPECIALLY AT RPM $<$ 7000 (EXHAUST NOZZLE FLAPS OPEN).

As soon as the aircraft is safely airborne, or as soon as the vertical speed indicator indicates a positive rate of climb :

- retract the U/C
- at 200 kt, retract the flaps (the "HIGH LIFT DEVICES" switch remaining on "NORMAL", the "auto slats only" function is restored).
- BEWARE OF SINKING.

Come back in for landing.



Duration : 2 min.
Fuel consumption : 80 litres

CAUTION

IAS VALUES GIVEN CORRESPOND TO A WEIGHT OF : 8700 kg ON FINAL
(1000 litres REMAINING FUEL) i = 10°

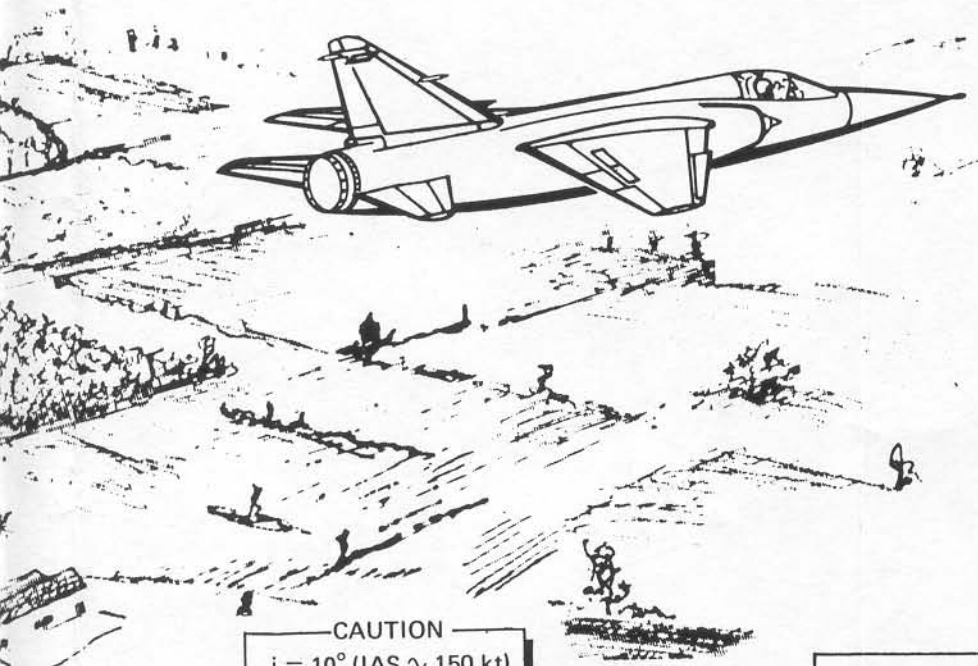
FIGURE 5 - BREAK

ABEAM RUNWAY THRESHOLD

IAS ∿ 215 kt
Hydraulic pressures : checked
High-lift device selector switch on «NORMAL»
«U/C» flashing
Airbrakes in
U/C down and locked
Flaps : all down
«CROSSFEED» : «ON»
Harness : adjusted/locked
Sight : approach
Anti-skid (SPAD) : tested
(«BRAKES» light must remain out)
Nose wheel steering : light out
Landing light : on

OWNWIND LEG
ilize speed before final turn

60°bank



BREAK IAS = 350 kt

- Throttle back to RPM ⩾ 6500
- Airbrakes as required

CAUTION
i = 10° (IAS ∿ 150 kt)
RPM ∿ 7300
Slope ∿ 2.5°

FLARE-OUT

STRAIGHT LINE FINAL APPROACH

RPM > 7000
practically identical
to a GCA final

UPON TOUCHDOWN i = 13°

IAS ∿ 135 kt
Throttle back

1 NM

300 ft

DO NOT EXTEND AIRBRAKES DURING FLARE-OUT
It is recommended not to use airbrakes on final

ON SHORT FINAL, DO NOT THROTTLE BACK BELOW 7000 RPM SO AS TO MAINTAIN GOOD ENGINE RESPONSE

FINAL

Duration : 2 min. 45 sec.
Fuel consumption : 80 litres

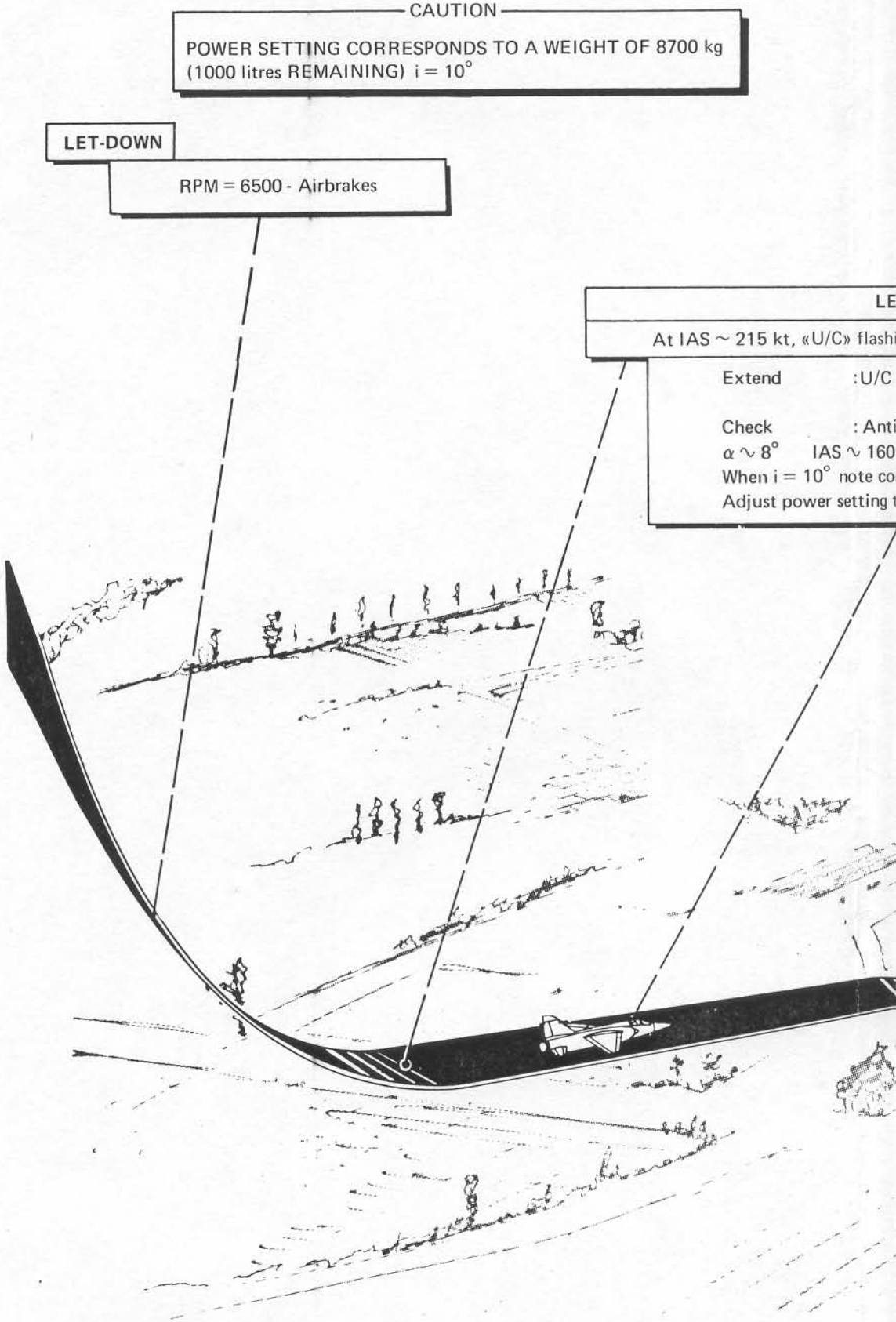

CAUTION
POWER SETTING CORRESPONDS TO A WEIGHT OF 8700 kg
(1000 litres REMAINING) i = 10°
LET-DOWN
RPM = 6500 - Airbrakes
LE
At IAS ~ 215 kt, «U/C» flashi
Extend :U/C
Check : Anti
α ~ 8° IAS ~ 160
When i = 10° note co
Adjust power setting t

FIGURE 6 - GCA or ILS PATTERN

LEVELLING-OFF

«U/C» flashing, retract airbrakes, check «ANC»

:U/C - Full flaps

: Anti-skid - Nose wheel steering
IAS ∿ 160 kt RPM ∿ 7400
10° note corresponding speed against index
ower setting to maintain this speed (IAS ∿ 150 kt)

INITIATION OF DESCENT

Reduce power setting by ∿ 100 rpm
Reduce attitude by 2.5°

VISUAL CONTACT

Do not throttle back to RPM < 7000 before touchdown

Hp = 200 ft

Disengage autopilot

UPON TOUCHDOWN

IAS ~ 135 kt
i = 13°

FLARE-OUT

2,35 - USE OF AUTOPILOT

The autopilot is engaged by depressing the «AP» pushbutton while holding the autopilot disconnect trigger depressed on the control stick grip.
As soon as the amber «AP» pushbutton light comes on, connection can be made throughout the permissible flight envelope (See SECTION 3, para. 3,35).

1 - CLIMB

After having established the climb attitude, connect the autopilot by releasing the trigger on the control stick grip and correct the attitude by means of the pitch beep trim.
It is preferable to make large corrections with the autopilot disconnected.

2 - CRUISE

Altitude Hold

With the autopilot already operating with the basic functions connected : after bringing the nose of the aircraft on the horizon by disconnecting (or using the beep trim), engage the altitude function by depressing the «ALT» pushbutton which illuminates.
The altitude is stabilized after a delay of approximately 2 minutes.
An altitude can be captured directly without previous leveling-off. In this case, avoid vertical speeds > 5000 ft/min.

CAUTION

OPERATION IN THE ALTITUDE HOLD MODE AT LOW SPEED WITH INSUFFICIENT ENGINE POWER MAY RAPIDLY LEAD TO HIGH ANGLES OF ATTACK AND THUS PLACE THE AIRCRAFT IN A HAZARDOUS CONFIGURATION. THE PILOT MUST OBSERVE THE ANGLE-OF-ATTACK LIMITS APPLYING TO FLIGHT WITH AUTOPILOT (See para. 3,35.2).

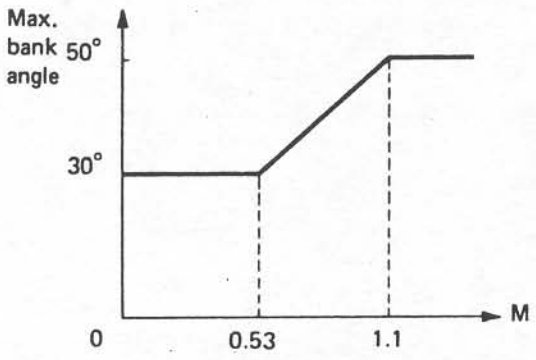
Heading Hold
It is performed :

- immediately, on connection if the bank angle is less than 10°
- through a blip or a prolonged action on the roll trim for selection of a heading when the bank angle upon connection exceeds 10°

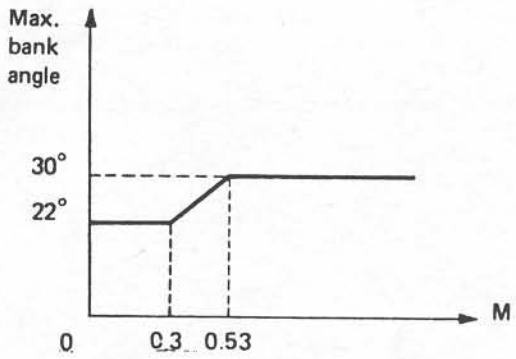
In this function, the autopilot intercepts and then holds the selected heading.
The moving index of the navigation indicator represents the selected heading.
This function can also be used in climbs and descents.

Turns
They are performed :

- in the selected heading function, by setting the desired roll-out heading on the navigation indicator by means of the roll trim. The bank angle limitations are as follows :



(a) Flight without pylon tanks, or
Flight with pylon tanks at H < 28,000 ft



(b) Flight with pylon tanks at H > 28,000 ft

- in the basic functions :
  - . by using the roll beep trim (short blip < 1 second) for small corrections of present heading (≤ 30°)
  - . by disconnecting and then connecting at the desired bank angle between 10° and 60°. Between 60° and 65°, the autopilot brings the aircraft to 60° on connection ; beyond 65°, connection is no longer possible.

3 - ACCELERATION/DECELERATION

On passing through the transonic range, the autopilot reverts to the basic functions. The green section of the «ALT» pushbutton is flashing. The altitude hold function is automatically disengaged and then reengaged at the new altitude after passing through the transonic range.

4 - DESCENT

In descent, the autopilot is used as described above. When leveling off and particularly for GCA or ILS approaches, it is preferable to first adjust the nose attitude with the pitch beep trim or by disconnecting the autopilot to avoid overshooting the selected altitude.

5 - ILS-GCA APPROACH IN ATTITUDE AND SELECTED HEADING HOLD MODE

- Place the aircraft in landing configuration in level flight (in altitude hold mode) and establish an angle of attack of 10°.
- Use of the pitch and roll beep trims is very effective.
  At the beginning of the approach, if a large correction is required, actuate the roll beep trim in long blips. When the required correction is small, apply short blips until the aircraft is lined up.
  The landing is made by disengaging the autopilot at Hp ≥ 200 ft.

6 - ILS APPROACH WITH AUTOPILOT IN LOCALIZER AND GLIDE SLOPE MODE

To perform the ILS approach, fly the aircraft to the localizer interception point at an angle less than 45° by selecting all the functions of the autopilot : «ALT», «R» (runway heading selected accurately) and «G» (the aircraft must be placed in landing configuration in level flight and the angle of attack must be 10°).

When approaching the beacon, the localizer beam is captured to line up the aircraft with the runway (the green section of the «R» pushbutton illuminates). Then the glide slope beam is captured and the descent is automatically initiated (the green section of the «G» pushbutton illuminates - Reduce engine rpm by 100 approx.).

At Hp ≥ 200 ft, the pilot must disengage the autopilot with the quick disengage lever in order to perform the landing.

CAUTION

DURING THE ALTITUDE HOLD PHASE, THEN GLIDE SLOPE HOLD PHASE, MAKE SURE ENGINE POWER IS SUFFICIENT TO OBSERVE THE ANGLE OF ATTACK AND INDICATED AIRSPEED. FOR A HEAVY AIRCRAFT, IT IS RECOMMENDED TO EXTEND 1/2 FLAPS IN LEVEL FLIGHT AS SOON AS PRACTICABLE.

NOTE : - During localizer beam capture, the maximum commanded bank angle is 30°.
- The «ALT» mode is recommended, but not indispensable.
- In order to obtain a correct steering schedule, the radio-altimeter should be turned on before the glide slope beam is captured.

TAKING THE CONTROL STICK GRIP BACK IN HAND (depressing the trigger) DISENGAGES THE SPECIFIC FUNCTIONS AND DISCONNECTS THE BASIC FUNCTIONS.

An action on the quick disengage lever at the bottom of the control stick grip disengages the autopilot.

A second action extinguishes the control box.

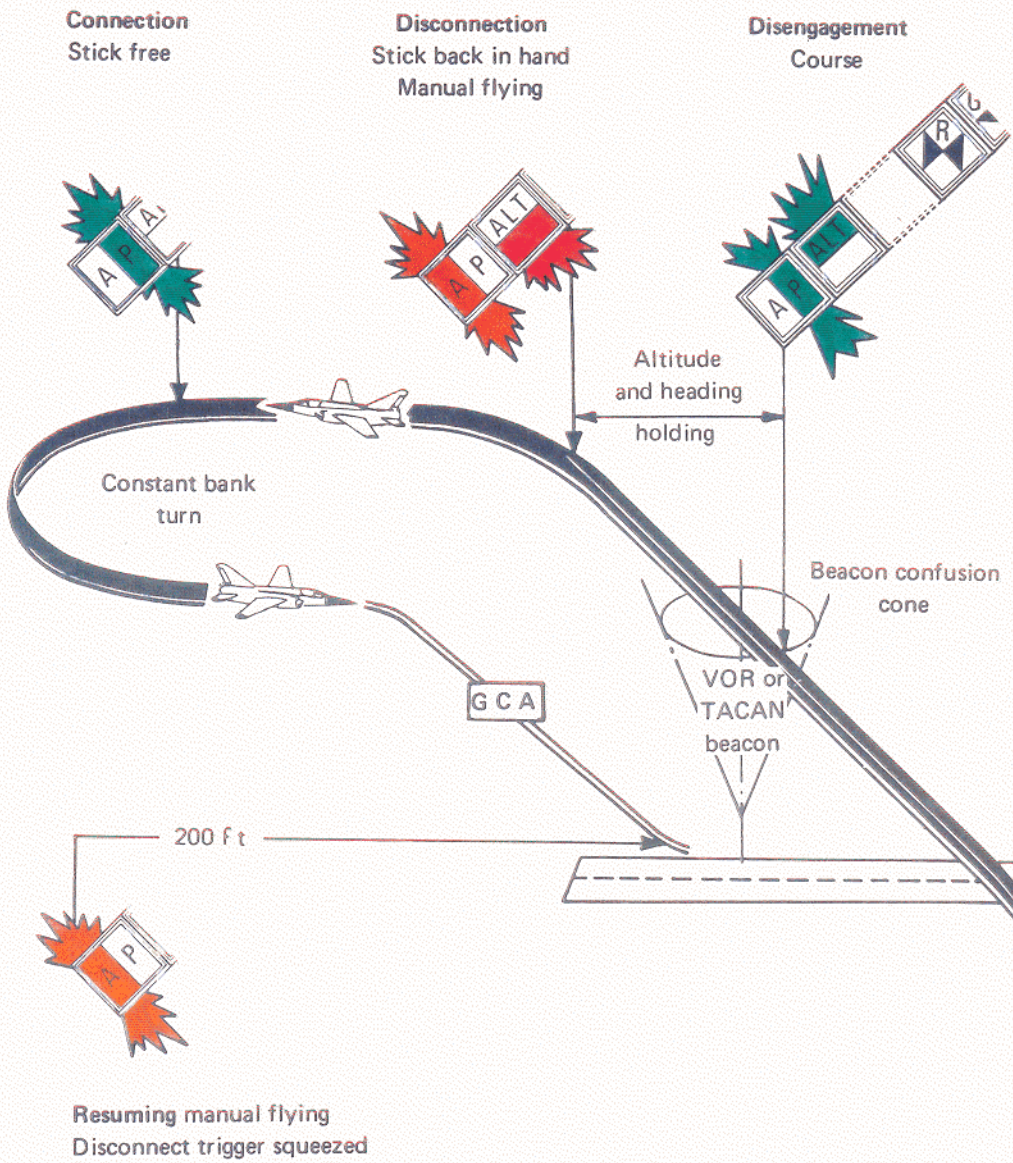
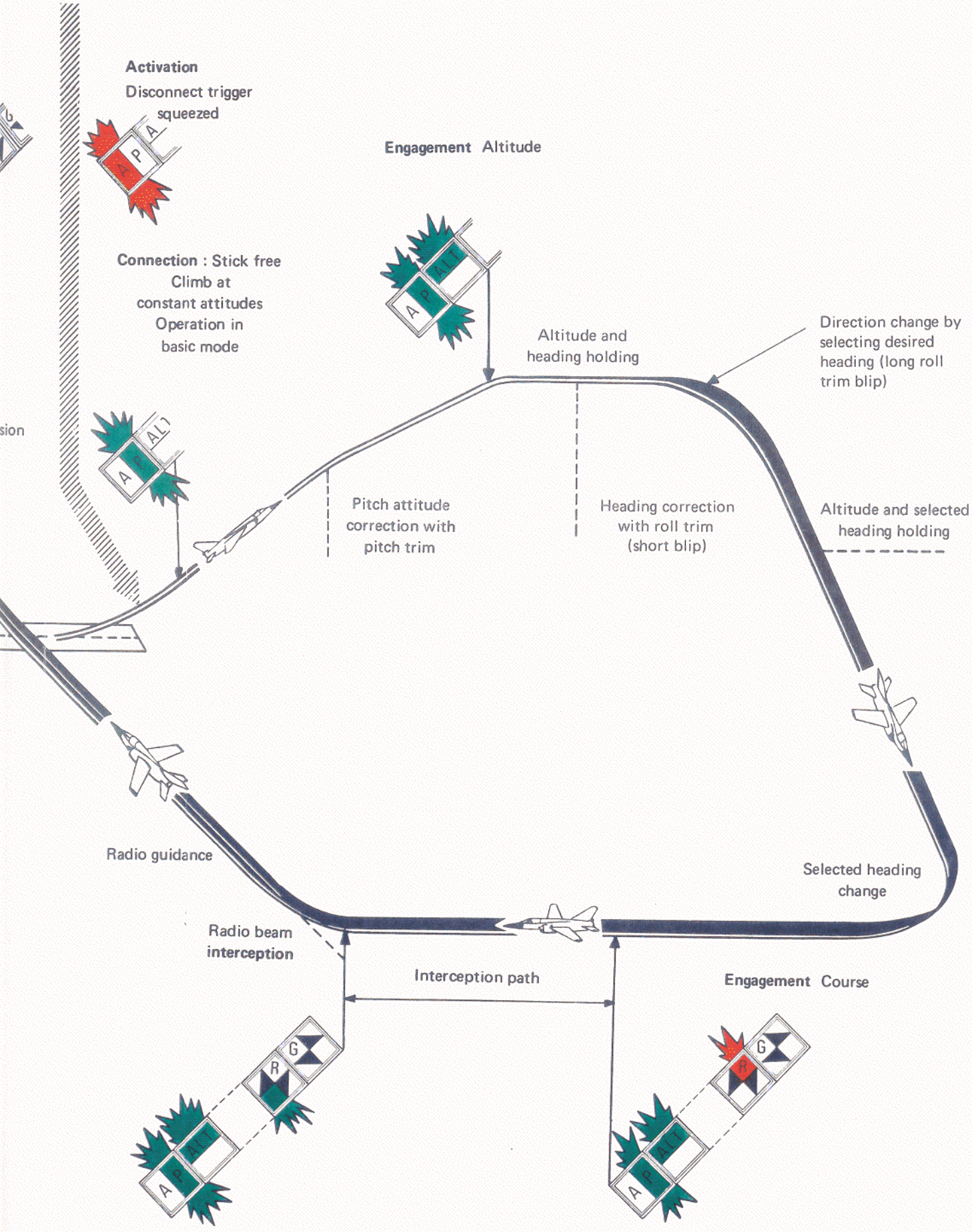


FIGURE 1 - TYPICAL AUTOPILOT OPERATION AND INDICATIONS


Activation
Disconnect trigger squeezed
A
A P
Engagement Altitude
Connection : Stick free
Climb at
constant attitudes
Operation in
basic mode
ALT
A P
Altitude and
heading holding
Direction change by
selecting desired
heading (long roll
trim blip)
Pitch attitude
correction with
pitch trim
Heading correction
with roll trim
(short blip)
Altitude and selected
heading holding
Radio guidance
Selected heading
change
Radio beam
interception
Interception path
Engagement Course
G
R

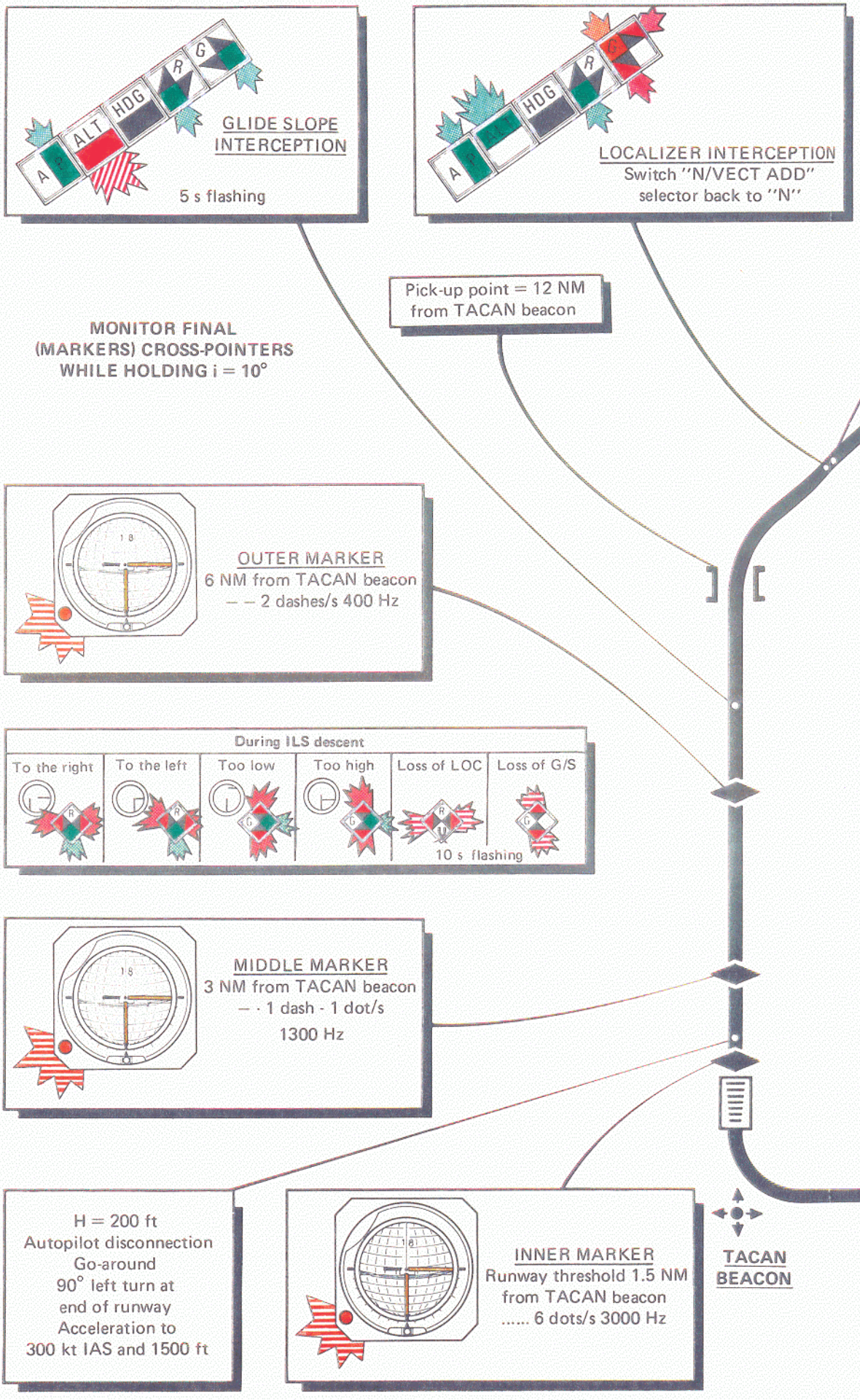
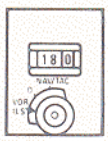
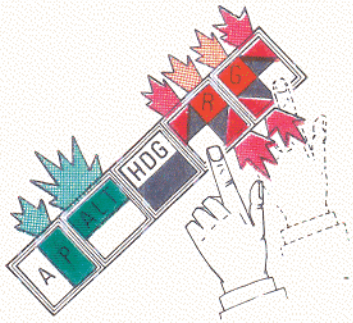


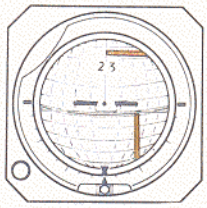
FIGURE 2 - TYPICAL AUTOPILOT OPERATION AND INDICATIONS - ILS

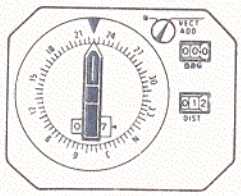
CEPTION
ADD"
'N"



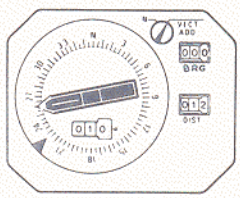
Set selector to VOR/ILS



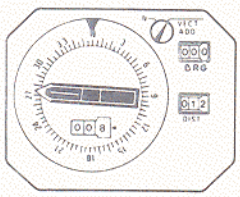




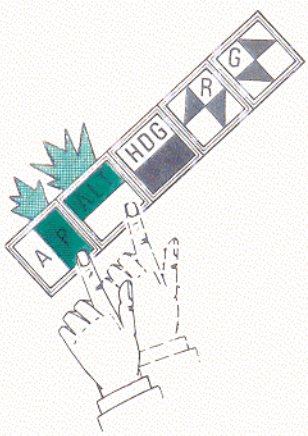
- "R" and "G" pushbuttons depressed
- U/C, Flaps } Down
- Establish i = 10°
- Heading corrections if required; fly to pick-up point
- Wait for localizer interception

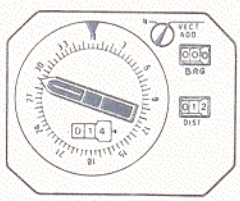


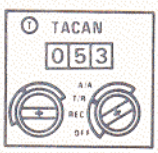
Clock tripping + 45
- Turn to heading 225

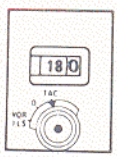


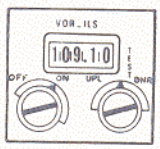
RPM : 7000
Trip clock











- "AP" and "ALT" pushbuttons depressed
- VOR/ILS course = 180
- ILS frequency = 109.10
- Set NAV IND "N/VECT ADD" selector to "VECT ADD"
- Vect. add 12 NM/000 = Pick-up point

At 5 NM
90° left turn
to heading 360

COME IN CONDITIONS :

Heading : 360 - Alt. : 1500 ft QFE (AGL)
Lateral spacing : 8 NM
IAS : 300 kt
RPM : 7300

- ILS

2,40 - RETURN TO PARKING AREA

- Select nose wheel steering high sensitivity . (button depressed)

1- AFTER CLEARING RUNWAY

- Demist switch	off
- IFF	«OFF»
- VOR	«OFF»
- TACAN	«OFF»
- Radar	«STBY»
- Probe heat switch	«OFF»
- BF radar detector switch	«OFF»
- Warning horn switch	«OFF»
- Radio-altimeter	«OFF»
- Landing light control	off
- Slats and flaps	up
- High-lift device selector switch	«OFF»
- Trims	neutral

Starting of FLIGHT CONTROL, COMBAT HIGH-LIFT DEVICE AND AUTOPILOT INTERLOCK test
AIRCRAFT STOPPED

NOTE : Do not reset the static inverter during the test.

- «DAY/NIGHT» selector switch	«DAY»
- «SLATS/FLAPS» selector switch	«NORMAL»
- Combat flap lever	out (through combat flap button)
- «CBT.F» light	continuously on
- Slats and flaps	checked down
- Flight control test switch	«ON»

During testing, check the following :

- «LIM» warning light	on + warning horn
- S/F light	on
- Slats and flaps	retract (the slats remain in the «auto slats only» position). «LIM» warning light out and warning horn stopped
- Combat flap lever	in ; S/F light out
- «CBT.F» light	out
- «SLATS/FLAPS» selector switch	«OFF». Slat retraction completed

Check that test stops at 35

- Depress «AP» pushbutton : Autotrim interlock test
- At 40, depress «ALT» pushbutton : Autopilot interlock test
- Wait for 88 . . . . . close guard

This test is to be performed upon return from the first flight of the day, and reported on the aircraft form.

AIRCRAFT STOPPED, WITH TAIL FACING A CLEAR AREA, PERFORM THE FOLLOWING TWO TESTS ONCE A WEEK :

A - AUXILIARY SERVOCONTROL BARREL 2 TEST

- Connect the autopilot (green «AP» pushbutton illuminated)
- Actuate the «STICK UNCOUPLE» switch

Check :
. for illumination of the red [AP] light on the failure warning panel
. for flashing of the amber «AP» pushbutton
. for free movement of the control stick by actuating it

- Reset the «STICK UNCOUPLE» switch to its normal position
- Depress the autopilot disengage lever
- The lights go out

B - EMERGENCY REGULATION TEST (post- or pre-Mod. 309 engines)

- Throttle	idle
- Emergency regulation switch	on
- Emergency regulation light	on
- Actuate the control lever by short blips until engine rpm increase is noted (record the value obtained)	
- Select military thrust with throttle	
- Check engine rpm	8400 approx.
- Check that JPT remains steady (lower than 500° C)	
- Throttle	idle
- Check engine rpm	approximately equal to the engine rpm previously obtained with the control lever
- Emergency regulation switch	off (guarded)
- Emergency regulation light	out
- Check for restoration of idle conditions	

NOTE : If the engine has to be shut down after this test, set an engine power of about 7200 rpm for about 2 minutes using the throttle, which enables the bearing 1 emergency lubricating oil to be recovered.

THESE TESTS WILL BE REPORTED ON THE AIRCRAFT FORM.

2- ON PARKING AREA, chocks in place or parking brake set.

With idle rpm stabilized (from right to left) :

- Air conditioning	«OFF»
- Oxygen	check remaining quantity
- Armament control panel	pushbuttons released
- Gyro reference system	«OFF»
- Emergency gyromagnetic compass	«OFF»
- Radar - Sight - Searchlight switch - Electric pump switch - Standby horizon switch - Navigation indicator	«OFF»
- Standby horizon	caged
- U/C control lever safety	in place
- Intercom control box	«AMPLI 1»
- V/UHF (red)	«OFF»
- V/UHF (green)	«OFF»
Then : - Throttle	STOP

- Start timing engine run-down time and record it (this time is specific to the aircraft/engine assembly)

Wait for engine to stop rotating

- LP pumps (all three) ..... off

In case of fire in the AB duct, restart the engine (Para. 4,25.7, SECTION 4)

- LP main cock switch ..... off (leave AB main cock open)

Wait for 5 seconds ..... (cock closing time)

- Battery + Night lighting ..... off, before ground crew installs access ladder
- Canopy ..... open

HAVE THE GROUND CREW FIT THE SAFETY DEVICES BEFORE LEAVING THE SEAT

Section 3

LIMITATIONS

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3,00 - GENERAL REMARK

CAUTION 1

IN NO CASE SHOULD THE ENGINE RPM EXCEED 9250
(«LIM» WARNING LIGHT ILLUMINATION AT 9200 RPM)

CAUTION 2

IN ALL OTHER CASES OF ILLUMINATION OF
THE «LIM» WARNING LIGHT, REDUCE AIRSPEED

3,10 - CLEAN AIRCRAFT LIMITATIONS WITHOUT USE OF AUTOPILOT

Engine limitations remain valid in these various envelopes

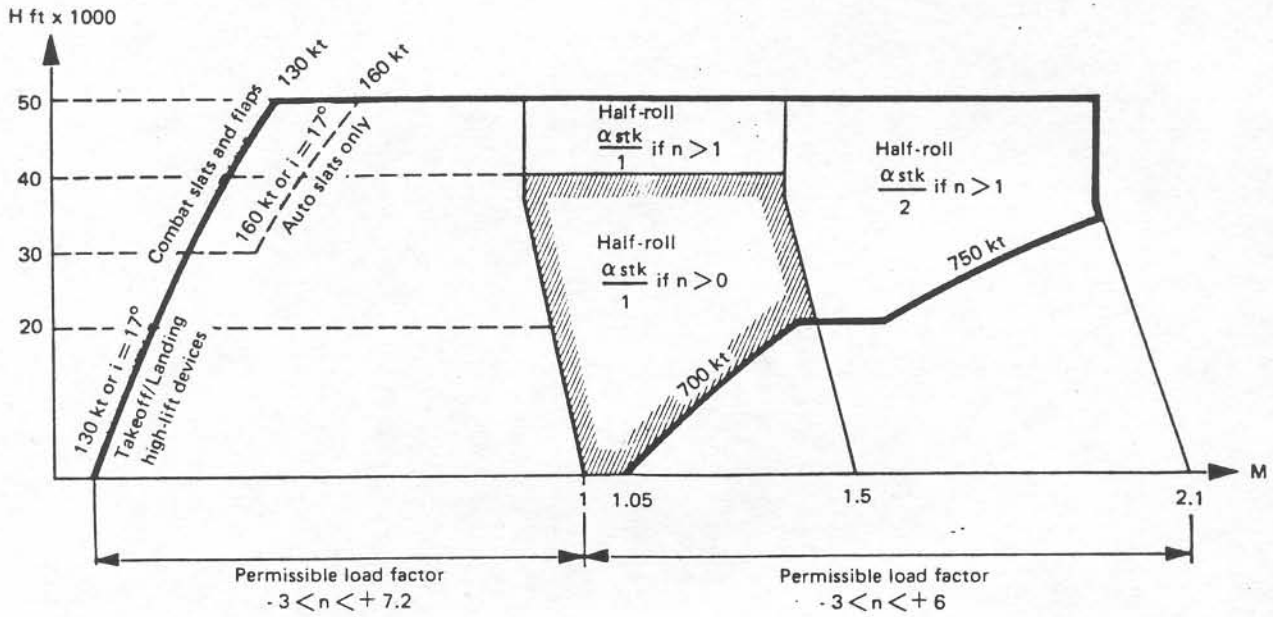


FIGURE 1 – CLEAN AIRCRAFT ENVELOPE

Abrupt roll maneuvers

Abrupt roll maneuvers should be limited so as to avoid :

- excessive skids (high Mach No. at low altitude)
- divergent flight conditions (high Mach No. at high altitude)

The following instructions should be observed in case of damper failure in maneuvering flight.

In subsonic conditions

Do not perform successive rolls.

In supersonic conditions

Half-rolls only are permissible.

- Up to M = 1.5, half-rolls may be performed with full roll control travel provided the load factor is higher than 0 below 40,000 ft and higher than 1 above 40,000 ft.
- Beyond M = 1.5, perform half-rolls with half roll control travel and load factors higher than 1.

- Total temperature : 135° C (M = 2.10 in standard atmosphere)
- Angle-of-attack reading = 17° except through transonic range : i = 15°
- Crosswind : 25 kt
- In supersonic flight, do not perform dive > 30°
- n ≤ 0 limited to 15 seconds (engine fuel supply)

3, 15 - ELECTRICAL LIMITATIONS

3, 15. 1 - ALTERNATOR VENTILATION

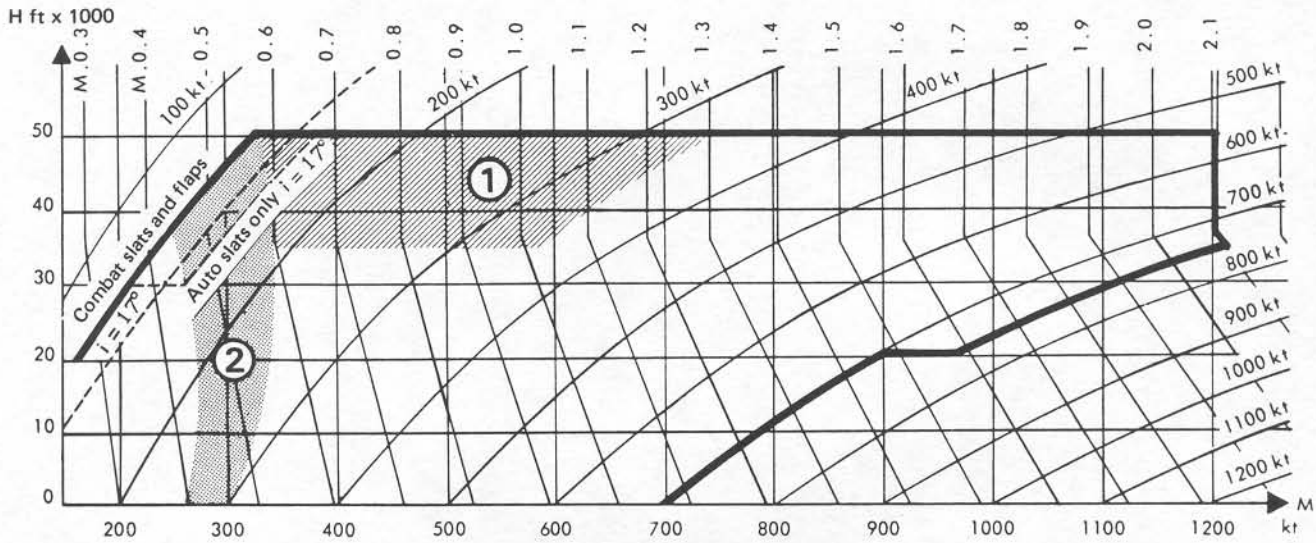


FIGURE 1 -- ALTERNATOR ENVELOPE

The alternators are ventilated by air bled from the air intake duct. During engine run-up or at low speed, the air intake duct is under negative pressure conditions and ventilation is consequently reversed. In flight, from a speed which mainly depends on the engine rpm and incidence, ventilation becomes direct.
There is a transition zone (zone 2) wherein ventilation is low. In addition, at high altitude, the air density is low and ventilation is not so efficient (zone 1).
The higher the electrical load, the higher the number of calories dissipated by the alternators.
The foregoing therefore results in the following instructions :

(1) HIGH-ALTITUDE FLYING

- In case of failure of one alternator :
  aircraft with missiles : do not maintain these flight conditions for more than 10 minutes.

(2) TRANSITION ZONE FLYING

a/ $Hp \geqslant 20,000$ ft : do not stay in same flight conditions for more than 10 minutes.

b/ In case of failure of one alternator
- $Hp < 20,000$ ft : do not stay in same flight conditions for more than 10 minutes
- $Hp \geqslant 20,000$ ft : if possible, stop missile operation ; do not stay in same flight conditions for more than 3 or 4 minutes

LOW-ALTITUDE APPROACH CONFIGURATION FLYING

- Missile operation must be stopped (the heating remains in service).

  To stabilize flight conditions (long level flight holding, U/C retraction failure, etc ....) : use full flaps and $i > 7°$.

- Failure of one alternator with prolonged steady flight conditions :
  - cut off the radar and one LP pump, which gives conditions equivalent to the preceding case if $W < 11,000$ kg (maximum landing weight).
  - if $W > 11,000$ kg, adopt the same procedure, but with $i \geqslant 9°$.

3,20 - LIMITATIONS WITH STORES

The approved configuration limitations are summarized in the tables of the Performance Manual (Book 3).

CAUTION 1

STRICTLY OBSERVE THE LIMITATIONS SPECIFIED IN THE PERFORMANCE MANUAL. ONLY THE CONFIGURATIONS INDICATED IN THE PERFORMANCE MANUAL ARE PERMISSIBLE.

CAUTION 2

WHEN THE AIRCRAFT CONFIGURATION INCLUDES A ROCKET LAUNCHER AT THE OUTBOARD STATION (STATION 2) WITH A STORE AT THE INBOARD STATION (STATION 1) (UNDER THE SAME WING), THE PROCEDURE TO BE APPLIED WILL BE AS FOLLOWS :

- BEFORE TAKEOFF, CHECK THAT THE JETTISON SELECTOR IS IN THE CENTER POSITION (INBOARD WING STATION)
- IF JETTISON IS NECESSARY, DEPRESS THE FOLLOWING IN SEQUENCE :
  . SELECTIVE JETTISON BUTTON
  . EMERGENCY JETTISON BUTTON

THIS PROCEDURE IS APPLICABLE ONLY TO AIRCRAFT NOT INCORPORATING MODIFICATION FX 139.

CAUTION 3

AT ALTITUDES BELOW 15,000 ft WITH THE ENGINE RUNNING AT MILITARY THRUST, DO NOT STABILIZE FLIGHT CONDITIONS CLOSE TO 600 kt OR M = 0.95 FOR MORE THAN 1 MINUTE IN THE FOLLOWING CONFIGURATIONS :

- TWO WING PYLON TANKS WITH OR WITHOUT BELLY STORE
- ANY CONFIGURATION IN WHICH THE DRAG INDEX IS CLOSE TO THAT IN THE PRECEDING CONFIGURATION.

Configurations with fuselage pylon tank

In the case of flight at high angle of attack, refer to the specific instructions in Chapter 5,10 (High angles of attack - Spins), paragraph 5,10.3.

3,25 - ENGINE LIMITATIONS

3,25.1 - ENGINE ENVELOPE (In clean aircraft envelope)

Within the hatched area, engine rpm must be increased slowly from stable parameters.

Envelope valid in standard atmosphere ± 10°C

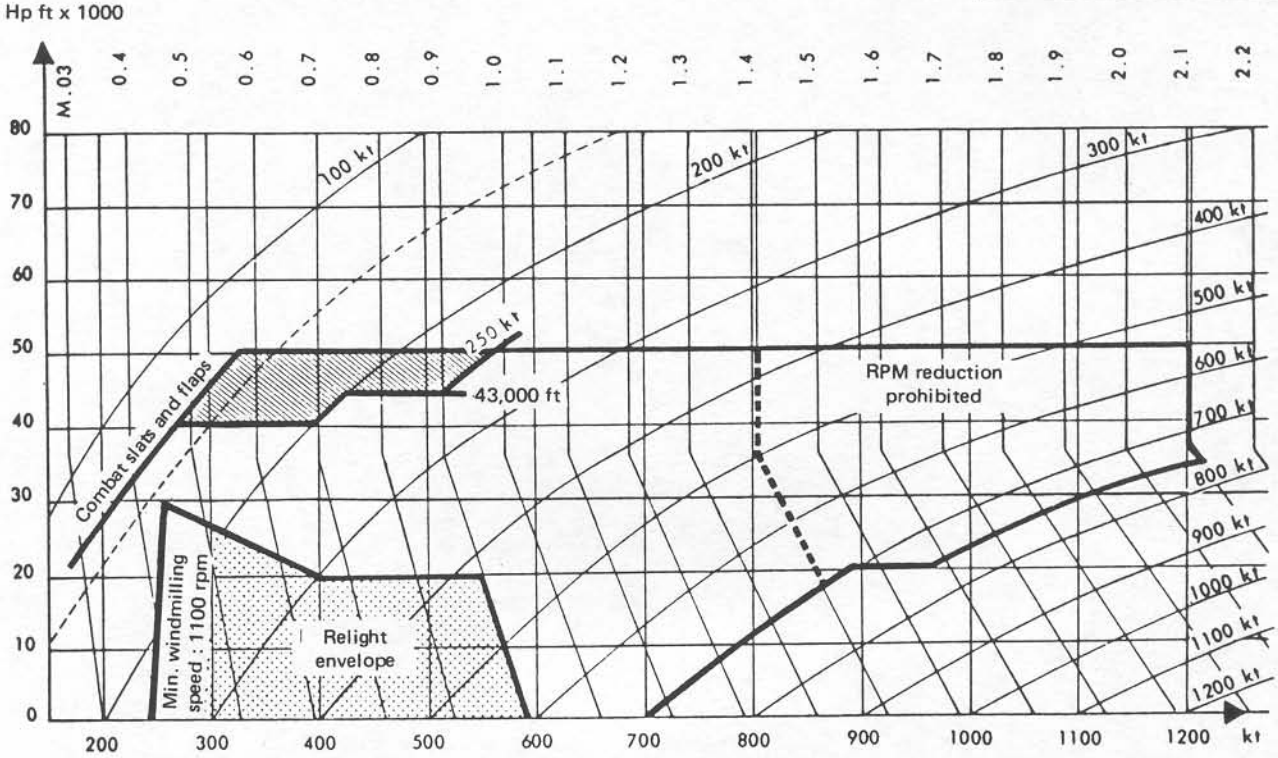


FIGURE 1 – ENGINE ENVELOPE

3,25.2 - USE OF AB

1- IGNITION AND THRUST VARIATION

AB ignition is permissible throughout the envelope (Figure 1). Within the hatched area, the AB ignition ceiling may be encountered as indicated by the «INJ» and «ON» lights coming on in turn. Do not allow this phenomenon to last for more than 10 seconds.

In the AB quadrant, all throttle movements between idle AB and max. AB are permissible.
AB overboost : The AB overboost is in automatic operation throughout the envelope at Hp ⩾ 27,500 ft.

NOTE 1 : The AB overboost must not operate below 27,500 ft ; therefore, in case of air data computer failure, do not use AB thrust greater than half AB except if necessary.

NOTE 2 : In case of use of TR4 (JP4) fuel, AB ignition is prohibited within the hatched area.

2- PROLONGED USE OF AB IN SUBSONIC FLIGHT

If the modification (thermal protection in engine compartment) has not been incorporated, the AB operating time above 35,000 ft in subsonic flight is limited to 5 minutes ; in addition, to provide for cooling that will allow the AB to be used again in same conditions, it is necessary to fly the aircraft for 5 minutes without the AB below 40,000 ft.
If the modification is incorporated, disregard these restrictions.

3,25.3 - COMPRESSOR CREEP

No restriction up to Tt = 135°C (illumination of «LIM» warning light).

3,25.4 - INVERTED FLIGHT

15 seconds.

3,25.5 - JPT

- Peak JPT on starting must not reach 900° C. Exceptionally, JPT ∿ 850° C is permissible for a period of less than 3 seconds.
- At full power with stabilized rpm, with or without AB, the temperature reading on the JPT indicator must remain within the following limits :

on the ground :	RPM = 8400 ± 60	740° C < JPT < 755° C
in flight :	RPM = 8400 ± 60	JPT < 760° C
	RPM = 8900 ± 60	JPT < 735° C

NOTE : These permissible tolerances apply to fixed RPM values (without fluctuations).

- Peak JPT permissible on throttle movements is 780° C for a period of 30 seconds maximum, and 840° C as instantaneous peak. Upon changeover to overspeed operation, JPT increases above 750° C and may reach 780° C for 10 to 20 seconds.

NOTE : In flight, JPT generally exceeds 740° C at 8400 rpm and 710° C at 8900 rpm. However, in certain flight conditions, such as high speed with AB or low speed at high altitude, the JPT at maximum engine rpm can fall and change with the AB thrust. The minimum value can reach 550° C.

3,25.6 - JPT REGULATOR

If necessary, the JPT regulator can be switched off in all flight conditions.

SWITCHING THE JPT REGULATOR BACK ON IS PROHIBITED WHEN RPM > 8300.

When the JPT regulator is switched off, avoid maintaining engine rpm for long periods between 7200 and 7800 (mechanical resistance of turbine).

3,25.7 - ENGINE RPM

Continuous limit : 9000 rpm.
Instantaneous peak limit : 9250 rpm.

In flight, stabilized power settings below 6500 rpm are provisionally prohibited.

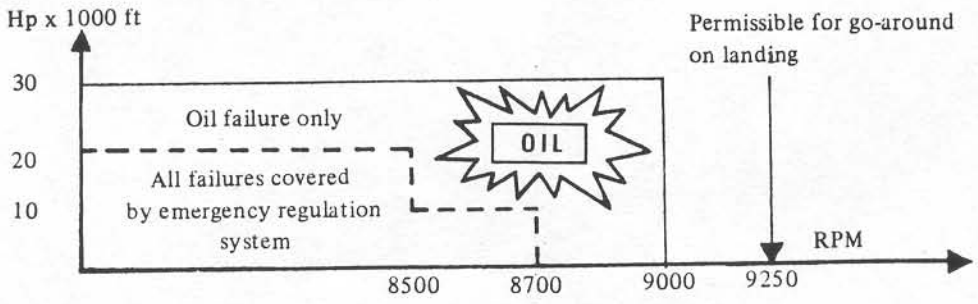
On the ground, stabilized power settings between 4000 and 5000 rpm are provisionally prohibited on aircraft equipped with an engine not incorporating modification 338 (incorporating modification 303 or not).

This restriction is not applicable to aircraft equipped with an engine incorporating modification 338.

3,25.8 - EMERGENCY REGULATION

Switch-on is prohibited in case of compressor stall.
Switch-on is prohibited during overspeed system operation.
Control lever actuation is permissible when M ⩽ 1 and Hp depending on the following envelope.

- The envelope for actuating the control lever is :



- Use engine rpm > 7200 only if necessary (limited turbine endurance with exhaust nozzle open). It is necessary to record the operating times.

3,25.9 - STARTER

- It is prohibited to depress the starter button when the engine is not completely stopped.
- The starter button must not be depressed for more than 2 seconds.
- Three successive attempts are permissible.
  If starting is unsuccessful after three attempts : WAIT 30 MINUTES AND CHANGE THE AIRCRAFT BATTERY before making a new attempt.

REMARK :

1 - In case of engine fire, the number of successive attempts, without any waiting period between them, is not limited.

2 - Any action on the starter button which causes operation of the electric starting motor (voltage drop in the battery system) is considered as an attempt.

3,35 - AUTOPILOT LIMITATIONS

3,35.1 - FLIGHT ENVELOPE WITH AUTOPILOT - WITHOUT EXTERNAL STORES

U/C and Flaps Up

500 ft < Hp < 1000 ft : IAS ≤ 450 kt
1000 ft < Hp < 20,000 ft : IAS ≤ 650 kt
20,000 ft < Hp < 36,000 ft : IAS ≤ 700 kt
36,000 ft < Hp < 50,000 ft : Mi ≤ 2

and at low airspeeds, observe the following limits :

$i \leq 11°$, IAS ≥ 200 kt (flaps up)
$i \leq 12°$, IAS ≥ 150 kt and Hp < 30,000 ft (flaps down)

All Down

Hp ≥ 200 ft

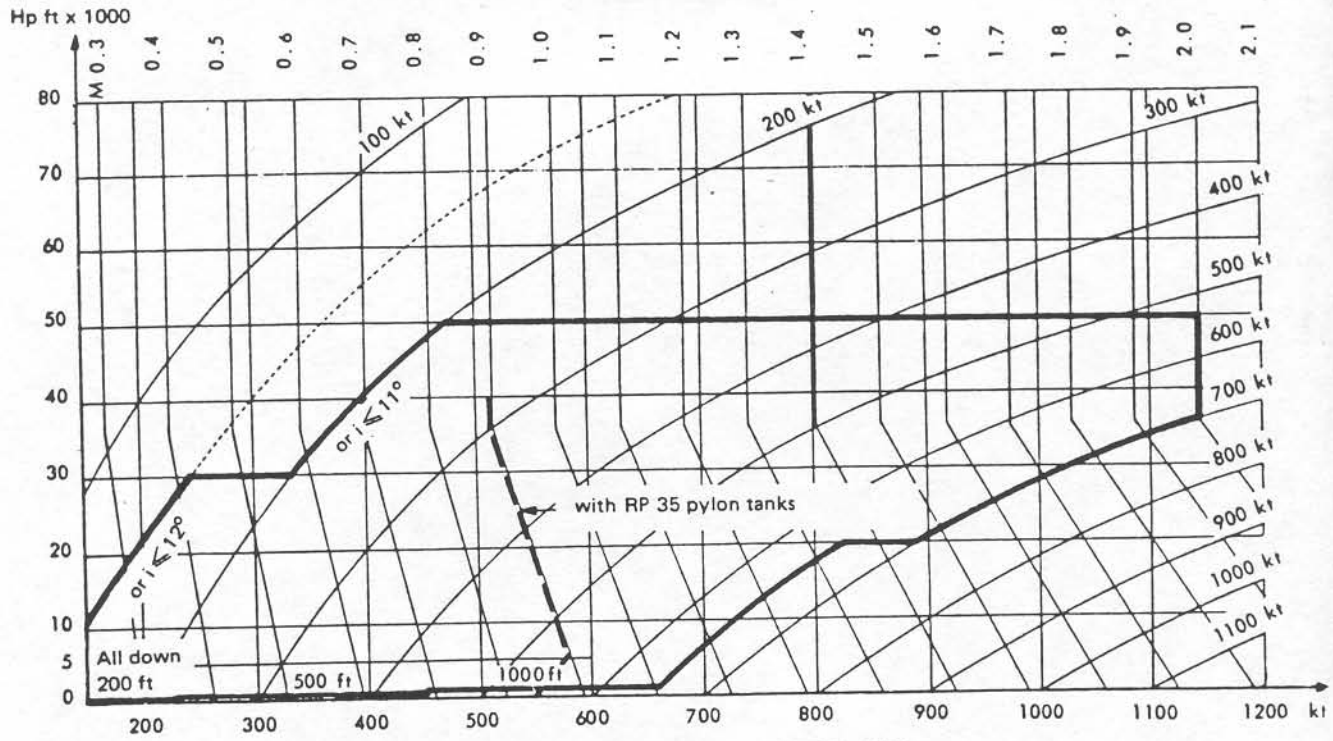


FIGURE 1 – AUTOPILOT ENVELOPE

3,35.2 - FLIGHT ENVELOPE WITH AUTOPILOT - WITH EXTERNAL STORES

The limitations are identical to those for aircraft without external stores ; however, the maximum permissible airspeeds or Mach numbers are inferior by 50 kt or 5 Mach points to those permissible in manual control mode.

Example : with RP 35 pylon tanks :
600 kt and M = 0.95 in manual control mode
550 kt and M = 0.9 in autopilot mode.

3,40 - ELEMENTS EXTENDED LIMITATIONS

3,40.1 - COMBAT HIGH-LIFT DEVICES

A - Auto Slats Only

IAS $<$ 470 kt
M $<$ 1.10

Maneuvering limit with auto slats down :

Same as for clean aircraft :

$-3\ g < n < +7.2\ g$, or
$i < 17°$ (warning horn)

B - Combat Slats and Flaps

IAS $<$ 335 kt
M $<$ 0.85

Maneuvering limit with combat flaps down :

$-3\ g < n < +7.2\ g$, or
$i < 17°$

3,40.2 - TAKEOFF/LANDING HIGH-LIFT DEVICES

Airspeed

1/2 flaps : IAS $<$ 300 kt

full flaps : IAS $<$ 225 kt

Load factor and angle of attack

full flaps : $0 < n < +2.5\ g$ or $i < 17°$

1/2 flaps : $i < 17°$

3,40.3 - U/C

The U/C and the aircraft structure are designed in accordance with Standard AIR 2004D for the following conditions :

Maximum take-off weight	:	15,200 kg		
Normal landing weight	:	9000 kg	R/D = 2.80 m/sec.	(550 ft/min.)
Exceptional landing weight	:	11,000 kg	R/D = 2 m/sec.	(395 ft/min.)

which correspond to limit structural loads that can be reached only exceptionally in the aircraft life.
In normal aircraft operating conditions, safe structural loads should not be exceeded and, consequently, the following rate of descent limits should not be exceeded at touchdown :

at 9000 kg	-	450 ft/min.
at 11,000 kg	-	350 ft/min.

CAUTION

IF IT IS ABSOLUTELY NECESSARY TO LAND AT A WEIGHT EXCEEDING 11,000 KG, USE THE LOWEST POSSIBLE RATE OF DESCENT (LOWER THAN 300 FT/MIN. IN ANY CASE).

The "LIM" warning light illuminates and the warning horn operates at IAS $\geq$ 240 kt when the nose U/C is not locked up or when the nose U/C doors are not locked closed.

The "U/C" warning light illuminates when IAS $\leq$ 215 kt as soon as the throttle lever is set to less than 8100 rpm.

NOTE : The contacts have a hysteresis of about 20 kt ; they are adjusted :
- in acceleration direction for the "LIM" warning light (240 kt contact)
- in deceleration direction for the "U/C" warning light (215 kt contact).

Therefore, the "LIM" warning light may stay on and the warning horn may keep operating down to 220 kt
the "U/C" warning light may stay on up to 235 kt.

3,40.4 - BRAKE CHUTE

Can be used up to 210 kt, including jettisoning.

3,40.5 - LANDING LIGHT

Landing light moving or extended when IAS $<$ 240 kt.

SECTION 4

EMERGENCY PROCEDURES

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4,00 - GENERAL REMARKS

4,00.1 - SAFE HEIGHT AND DECISION HEIGHT

CAUTION

SAFE HEIGHT 300 ft

DECISION HEIGHT 1500 ft

General :

The study has been done with a Mirage F1 C aircraft having a weight of 9 tons, a Martin Baker Mark IV seat and a canopy embrittlement system.

1 - SAFE HEIGHT

(1) In GCA-type final approach configuration at 160 kt IAS, with the undercarriage and landing high-lift devices extended, the rate of descent is 4100 ft/min and the flight-path slope is 17° in case of flameout.

The height required for the ejection sequence to take place properly is then 295 ft (start of pilot action towards blind firing handle) for a pilot's parachute deployment at 50 ft.

(2) The inflight relight configuration at IAS > 250 kt, with the undercarriage retracted and the auto slats extended, gives an equivalent value.

Both of these data have been considered to set the safe height to a value of 300 ft.

2 - DECISION HEIGHT

To obtain a positive vertical speed before reaching the ground, following a relight procedure, it is necessary to obtain the military thrust at the safe height at the latest.

Now, an emergency relight followed by full power climb requires about 15 seconds, which corresponds to an altitude loss ΔH of about 1200 ft. Therefore, above the safe height, there is an altitude range ΔH within which, in an emergency relight, it is not possible to obtain the military thrust before reaching the safe height.

Therefore, this ΔH must be added to the safe height to obtain the decision height which is the final limit to initiate a relight procedure.

NOTE : These heights are computed in relation to ground level. The corresponding altimeter indication should therefore be determined from the topography of the terrain overflown and the altimeter setting.

4,00.2 - FAILURE WARNING SYSTEM

For all failures causing a light to come on, and the warning horn to operate if applicable, keep in mind that it is just necessary to depress the master warning light to stop the warning horn, except for [0x REG] warning, and to reset the master warning light and warning horn assembly to provide for other failure warning.

4,00.3 - BLEED VALVE FAILURE

Night flying : in case of master warning, audio and visual, not identified at the failure warning panel, apply the following procedure :

- momentarily increase the intensity of the failure warning panel
- check the [B.O.V.] light
- if the light is on, apply the [B.O.V] failure procedure

4,00.4 - OIL FAILURE

Intermittent operation of the master warning light and warning horn, without indication at the failure warning panel, may indicate an impending oil failure.

4,10 - TAKEOFF - LANDING - ARRESTING BARRIER ENGAGEMENT

4,10.1 - TAKEOFF

1- BURSTING OF BOTH TIRES ON ONE U/C LEG

At IAS < rotation speed : abort takeoff

- shut off the AB and move the throttle to idle
- deploy the brake chute
- brake moderately with the antiskid system (hold the aircraft in the center of the runway with the nose wheel steering system)
- do not clear the runway unless safety is jeopardized
- use the emergency brakes, if necessary

At IAS > rotation speed : continue takeoff

- maintain max. AB
- keep the undercarriage and flaps extended
- burn up fuel, observing the alternator ventilation limitations
- land as instructed in para. 4,10.2

NOTE : On airfields not equipped with a barrier, use the lower V_{AS_1} or V_R speed.

2- ENGINE TROUBLES

In case of :

- engine flameout
- engine or AB fire + warning horn
- thrust drop
- severe vibrations
- OIL light on + warning horn
- L P light on + warning horn
- B.O.V. light on + warning horn

A - AIRCRAFT ON GROUND

Airfield equipped with arresting barrier (180 kt and over)

Airfield not equipped with arresting barrier

$IAS < V_{AS_2}$

- shut down the AB and move the throttle to idle
  in case of ENGINE or AB FIRE : close the throttle and the LP main cock
- deploy the brake chute
- brake with the antiskid system
  in case of ENGINE or AB FIRE : turn off the electrical switches, except the battery switch

If barrier engagement is unavoidable

- close the throttle and the LP main cock
- switch off the battery upon engagement
- do not brake upon engagement

CAUTION

If the brake chute is released at takeoff abort IAS between V_{AS_1} and V_{AS_2}, the decision :

- to eject (90 kt min - seat envelope)
- to add power and continue takeoff
- to definitively abort takeoff

will depend on the failure and the nature of the terrain at the end of the runway (ground, obstacles, etc).

$IAS > V_{AS_2}$

Refer to para. B : Aircraft Airborne

NOTE : Speeds V_{AS_1} and V_{AS_2}, defined in para. 2,15.4/1, SECTION 2, can be determined in BOOK 3 - PERFORMANCE DATA.

B - AIRCRAFT AIRBORNE

- Engine flameout or confirmed fire : EJECT

Other cases of failure :

- Thrust drop
- OIL light on

} JETTISON THE STORES

- retract the undercarriage
- retract the flaps at 200 kt
- maintain FL AB and attempt to reach H > 1500 ft at IAS > 250 kt

If IAS drops in level flight : EJECT

- at H ⩾ 1500 ft and IAS ⩾ 250 kt : apply the procedure corresponding to the concerned failure or the specific procedure : OIL light on during takeoff.

SPECIFIC PROCEDURE : OIL light on during takeoff

- maintain H ⩾ 1500 ft and IAS ⩾ 250 kt
- shut down the AB
- throttle back to RPM ⩽ 8000
- turn the emergency regulation switch on
- select the necessary engine rpm by actuating the emergency regulation control lever in a continuous way (continuous rpm limit : 9000)
- move the throttle to idle
- land as soon as possible (20 min lubrication endurance)

3- EMERGENCY JETTISON (See Book 3)

4,10.2 - LANDING

1- BURSTING OF ONE TIRE :

- use the brake chute on landing, then brake with the antiskid system
- return to the parking area

2- BURSTING OF BOTH TIRES ON ONE U/C LEG :

- land on the half-side of the runway opposite to the burst tires
- deploy the brake chute
- bring the nose wheels on the ground
- brake moderately (with the antiskid system) as required
- use the emergency brakes if necessary
- shut down the engine if it is impossible to avoid overshooting the runway
- do not clear the runway unless safety is jeopardized

3- GO-AROUND

The procedures for failures occurring during go-around are identical to those occurring during takeoff from airfields equipped with a barrier.

On airfields not equipped with a barrier, the pilot's judgement is the sole determining factor, taking into account the V_{AS_1} and V_{AS_2} calculated for takeoff.

4,10.3 - ARRESTING BARRIER ENGAGEMENT

- deploy the brake chute
- tighten the harness
- DO NOT EMBRITTLE THE CANOPY
- move the throttle to STOP just before engaging the barrier
- turn LP main cock off
- aim for the center of the net (nose wheel steering system)
- do not cut off the battery until the barrier is engaged
- AVOID BRAKING during engagement
- DO NOT BRAKE during backward motion

Jettison of external stores is not recommended on the ground.

4,15 - ELECTRICAL SYSTEM

BATT light on + warning horn

- check the battery switch
- try to reset (three times)
- if the failure persists, leave the switch on
- check that TR.1 and TR.2 lights are out
- avoid all risks of engine flameout
- return to base

ALT.1 light on - EMG~ light may come on

or

ALT.2 light on

The aircraft remains operational, except load shedding of 550 missiles if the engine rpm drops below 5600.

- check the switch
- reset two or three times with an interval of 5 to 10 seconds between each attempt
- if the failure persists, leave the switch off

If the EMG~ light is on

- reset the inverter
- the EMG~ light should go out
- return to base

See alternator ventilation limitations (para. 3,15, SECTION 3).

CAUTION

THE 550 MISSILE GYROS ARE LIABLE TO BE DETERIORATED IN THE FOLLOWING TWO CASES :
- UPON STARTING, ENGAGEMENT OF ONLY ONE ALTERNATOR, FOLLOWED BY 550 MISSILE CONNECTION.
- IN FLIGHT, FAILURE OF ONLY ONE ALTERNATOR WITH THE 550 MISSILES CONNECTED, AND BACKWARD THROTTLE MOTION.

ALT.1 + ALT.2 lights on - TR.1 + TR.2 EMG~ lights also on

- try to reset both, then one at a time while switching off the other ; if no result :
- proceed to maximum load shedding (load shedding of the utility DC subsystem being automatic)
  - . probe heater (according to weather conditions)
  - . V/UHF, avoid transmitting
  - . flying aids : switch off «PITCH» and «YAW»
  - . ARTHUR : select «LOW ARTHUR»
  - . night lighting : reduce intensity to a minimum

  The only remaining electrical power source is the battery which has an endurance of at least 13 minutes (without using the electric pump)
- set the heading selector to «EMG»
- land as soon as possible

If HYD.2 light comes on, it is a failure of the A/C accessory drive.

- extend the U/C in the normal mode as soon as possible before exhaustion of the battery

EMG~ light on

- check «INV CONT» and «INV POW» circuit breakers
- check that the inverter selector is at «AUTO»
- reset two or three times if the alternators are correct
- do not reset if the alternators hunt, and set the inverter selector to «INV»
- flight can be continued

TR.1 light on

or

TR.2 light on :

- reset two or three times with an interval of 5 to 10 seconds between each attempt
  If resetting is not possible, the remaining T-R is capable of supplying the DC system except when the electric pump is in operation.
  If operation of the electric pump is necessary (hydraulic system 1 failure) :
  . load shed DC system (V/UHF, IFF...)

TR.1 + TR.2 lights on :

- reset
  If both T-R's remain inoperative :
  . proceed to maximum load shedding on DC system
  The only remaining DC power source is the battery
  . return to base

MODUL light on + warning horn :

On the ground :

- select 6000 rpm minimum
  If the failure persists, switch off «ALT.2»
- abort the mission

In flight :

- change rpm setting
  If the failure persists, switch off «ALT.2»

(1) The light remains on
- leave «ALT.2» off
- return to base

Pay attention to alternator ventilation

(2) The light goes out
- switch «ALT.2» back on

If the MODUL light is out, continue the mission
If the MODUL light is on, switch off «ALT.2» again
- check that the MODUL light goes out and continue the mission in case of operational necessity ; otherwise, return to base

Pay attention to alternator ventilation

NOTE : In this case of failure, if an «ALT.1» failure occurs when «ALT.2» has been switched off, switch «ALT.2» back on.

COMPLETE ELECTRICAL FAILURE

All lights are out

- turn the «BATT» switch «OFF»
- turn the «ALT.1» switch «OFF»
- turn the «ALT.2» switch «OFF»
- turn the «BATT» switch back «ON»

The [ALT.1], [ALT.2], [TR.1], [TR.2], [EMG~] lights should come on

Turn the «ALT.1» switch back «ON»
The [ALT.1] light goes out
The [TR.1] and [TR.2] lights go out.
Resetting is successful.
Turn the «ALT.2» switch back «ON»
The [ALT.2] light goes out.
Reset the emergency system.

CAUTION

WHEN RESETTING ALTERNATOR 1, IF THE FAILURE WARNING PANEL LIGHTS GO OUT, TURN THE «ALT.1» SWITCH BACK «OFF».
RESET THE BATTERY AND ALTERNATOR 2.
THE [ALT.2] LIGHT THEN, ABOUT 2 SECONDS LATER, THE [TR.1] AND [TR.2] LIGHTS SHOULD GO OUT.

This procedure may be applied three times.
If unsuccessful :
- Switch off alternator 2.

If the failure persists :

- head to the nearest airfield
- avoid risks of engine flameout and probe icing
  (fly at low altitudes and moderate power settings)

(when returning to base, attempt resetting under the above-defined conditions)

On landing :
- extend the U/C in the emergency mode
- use the Mach/airspeed indicator on landing
  use the brake chute
  brake carefully

4,20 - FUEL SYSTEM

4,20.1 - ENGINE FUEL SUPPLY FAILURES

L P. light on + warning horn DURING TAKEOFF (See para. 4,10.1)

L P. light on + warning horn OUTSIDE OF TAKEOFF (Hp ⩾ 1500 ft, IAS ⩾ 250 kt)

- shut off the AB
- throttle back
- check that the LP switches are on and the L/H L P and R/H L P lights out
- land as soon as possible
- check the fuel remaining indicator and the fuel gage to detect a possible leak ; in case of leak, there is a risk of engine fire

L/H L P light on

- shut off the AB
- check the LH LP switch. If its position is correct (on) and the light remains on :
- open the crossfeed system
- turn the LH LP switch off

R/H L P light on

- shut off the AB
- check the RH LP pump switch. If its position is correct and the light remains on :
- switch off the RH LP pump (the starting pump operates)
- leave the crossfeed system closed
- keep watching the fuel gages

When the asymmetry becomes important :
- open the crossfeed system to reestablish symmetry and then close it again

R/H L P and L/H L P lights on

- carry out the instructions applicable to L P. light on
- if the failure persists :
  . switch off the LH and RH pumps (the starting pump still operates)
  . open the crossfeed system

IMPORTANT ASYMMETRY IN FEEDER TANK GAGE READINGS

With or without LP failure indication.
If this asymmetry is not accompanied by the illumination of the fuel transfer indicator lights in abnormal sequence :

- open the crossfeed system

The trouble is probably due to a defective LP pump.

4,20.2 - TRANSFER FAILURES

500 L light on (transfer in progress)

- shut off the AB
- check the feeder tank gages and the fuel transfer indicator

A - One Feeder Tank Gage Reads < 250 l

If the light illumination sequence is normal :

- the trouble is due to an important asymmetry

- open the crossfeed system

If the light illumination sequence is abnormal :

- open the crossfeed system
- if necessary, use the emergency fuel transfer system (See Transfer failures, para. 1,20.4, SECTION 1)

B - Both Feeder Tank Gages Read < 250 l + Fuel Transfer Indicator Lights On With or Without the 3 Lights (Pressurization Failure)

- reduce engine rpm
- descend to 20,000 ft approximately and head to the nearest airfield
- at this altitude, select 8000 rpm (30 seconds max.)
  - . if the fuel gage indications do not increase, use the emergency fuel transfer system
  - . if the fuel gage indications increase, continue flying at this altitude, if necessary

NOTES : 1- Whenever the emergency fuel transfer system is used, watch the feeder tank gages : if their indications decrease abnormally, turn off the emergency fuel transfer system.
2- In all cases, turn off the emergency fuel transfer system before the level flight leg preceding the final approach.

ABNORMAL INDICATION OF FUEL TRANSFER INDICATOR

A - All Lights are On With or Without the 3 Lights (Pressurization Failure)

- confirm the failure by increasing engine rpm if it was at full idle
- shut off the AB, slow down to subsonic and head to an airfield while descending to 20,000 ft approximately
- at 20,000 ft, readjust the engine rpm to about 8000
- if the failure persists more than 30 seconds and if the 3 and 5 tank fuel has not already been consumed, use the emergency fuel transfer system

In this case, a maximum of 2000 liters of consumable fuel remains

CG will be forward on landing.

B - Non-Illumination of One Light on One Side

- test the fuel transfer indicator and read the fuel gage indications.

If the gage readings are in the transfer range :

- do not open the crossfeed system as long as the 500 L. light remains out

When the 500 L. light comes on :

. if 1 or 2 or 4 light is out :

- the corresponding fuel is lost

. if 3 + 5 or 5 lights are out :

- open the crossfeed system
- use the emergency fuel transfer system

C - Excessive Transfer Asymmetry

Excessive asymmetry may be caused by jamming of a transfer sequence slide-valve selector valve in the intermediate position. In such a case, cycling the transfer sequence selector switch (clean/pylon tanks) may unjam the selector valve and resume normal fuel transfer.

If the asymmetry persists, open the crossfeed system while closely watching the transfer sequence.

ASYMMETRY OF FEEDER TANK GAGES

A - Transfer Indicator Light Illumination Sequence is NORMAL

- open the crossfeed system (possible LP pump failure)

The end of transfer of one wing pylon tank occurs too soon :

- open the crossfeed system until end of transfer of the other tank, then close the crossfeed system

B - One Feeder Tank Gage is at the Maximum Level

- do not open the crossfeed system
- wait for the end of transfer of the tank corresponding to the defective valve

FUEL CANNOT BE TRANSFERRED FROM ONE WING PYLON TANK

This failure involves an aircraft asymmetry which cannot be fully reabsorbed by roll trim.
However, residual force makes it possible to land without jettisoning the pylon tanks.

The fuel of the corresponding tank cannot be consumed

- precautionary landing

4,25 - ENGINE

4,25.1 - ENGINE STARTING INCIDENTS

4,25.1.1 - DURING TURBOSTARTER STARTING

If the turbostarter sequence stops :

- if the RPM indicator has started registering : attempt a new start after complete engine stop

- if the RPM indicator has not started registering : observe the ground crew signal :

If the ground crew has observed turbostarter ignition, he signals to the pilot :
- to attempt a new start immediately.

If the ground crew has not observed turbostarter ignition, he signals to the pilot :
- to switch off the starting LP pump
- to wait 1.5 minutes before attempting a new start.

If the starter continues to operate with no engine ignition occurring :
- pull out the «START» circuit breaker.

4,25.1.2 - DURING ENGINE STARTING

When one of the following cases occurs :

- the engine rpm does not increase beyond 1300
- the engine chatters without accelerating
- no JPT indication
- the JPT increases rapidly and exceeds 700° C
- the OIL light goes out before the engine rpm reaches 2000.

SHUT DOWN THE ENGINE IMMEDIATELY

- move the throttle to STOP
- switch off the starting LP pump

Engine ignition does not occur :

- move the throttle to STOP
- wait until the engine stops, then
- switch off the starting pump
- switch to the other plug
- repeat the starting procedure (after complete engine stop)
- cancel the flight

If the second attempt has failed and there has been a flow of fuel :

- carry out a dry ventilation.

4,25.1.3 - DRY VENTILATION

- throttle . . . . . stop
- battery switch. . . . . checked on
- ignition/ventilation selector. . . . . ventilation
- starting circuit breaker . . . . . checked pushed in
- LP main cock switch . . . . . open (guarded)

Do not leave the LP main cock open for more than 15 seconds before starting the LP pumps or the starting pump.

- starting pump switch . . . . . on
- LH and RH LP pump switches. . . . . on
- [L P.] light. . . . . out

WARNING

BEFORE ACTUATING THE STARTER BUTTON, CHECK THAT THE ENGINE IS COMPLETELY STOPPED.

- depress the starter button for about 1 second
- leave the throttle at STOP

Observe the engine rpm, peak $1300 \leqslant rpm \leqslant 1800$.

Ventilation duration should be < 25 seconds.

If the sequence does not stop automatically within this period :

PULL OUT THE «START» CIRCUIT BREAKER.

4,25.1.4 - FAILURES ON GROUND

[B.O.V.] light on + warning horn

- change engine rpm
- if the light remains on at rpm < 6900, do not stabilize between 4000 and 5000
- cancel the flight

10

Engine ignition does not occur :

- move the throttle to STOP
- wait until the engine stops, then
- switch off the starting pump
- switch to the other plug
- repeat the starting procedure (after complete engine stop)
- cancel the flight

If the second attempt has failed and there has been a flow of fuel :

- carry out a dry ventilation.

4,25.1.3 - DRY VENTILATION

- throttle . . . . . stop
- battery switch. . . . . checked on
- ignition/ventilation selector. . . . . ventilation
- starting circuit breaker . . . . . checked pushed in
- LP main cock switch . . . . . open (guarded)

Do not leave the LP main cock open for more than 15 seconds before starting the LP pumps or the starting pump.

- starting pump switch . . . . . on
- LH and RH LP pump switches. . . . . on
- [L P] light . . . . . out

WARNING

BEFORE ACTUATING THE STARTER BUTTON, CHECK THAT THE ENGINE IS COMPLETELY STOPPED.

- depress the starter button for about 1 second
- leave the throttle at STOP

Observe the engine rpm, peak $1300 \leqslant rpm \leqslant 1800$.

Ventilation duration should be < 25 seconds.

If the sequence does not stop automatically within this period :

PULL OUT THE «START» CIRCUIT BREAKER.

REMARKS

- Any impulse on the starter button which causes operation of the electric starting motor (voltage drop in the battery system) is considered as a start attempt.

- If JPT stabilizes at 850°C for more than 3 seconds or exceeds 900°C, shut down the engine (technical inspection required).

- If JPT exceeds 850°C for less than 3 seconds without reaching 900°C, report the incident on the form.

- Downwind starting : As a general rule, it is necessary to head the aircraft into the wind. If this is impossible or inconvenient, an exhaust nozzle protective panel must be used.

ENGINE OR AB FIRE : refer to para. 4,60 - Fire.

4,25.2 - ENGINE FAILURES

1- [OIL] or [B.O.V.] light on : DURING TAKEOFF (See para. 4,10.1)

2- [OIL] light on : IN APPROACH (See para. 5,25.6 - SECTION 5)

3- OUTSIDE OF TAKEOFF

[OIL] light on + warning horn ; WATCH ENGINE RPM TO AVOID OVERSPEED

- shut off the AB, decelerate rapidly to M = 1.4 and move the throttle to idle
- at M < 1.4, emergency regulation switch to on (start stopwatch)
- slow down to subsonic
- as soon as M < 1.0 and Hp < 30,000 ft :
  select the necessary engine rpm by actuating the control lever in short steps (avoid limit rpm, 9250 peak rpm)
- land as soon as possible : a maximum of 20-minute lubrication endurance remains

If go-around is necessary on landing, the control lever can be actuated continuously.

CAUTION

IN NO CASE, EXCEED 9250 RPM

NOTE : If the maximum rpm is exceeded :

- move the throttle to STOP
- relight in the emergency regulation mode

[B.O.V.] light on + warning horn

On Ground

After starting, any illumination of the [B.O.V.] light shall be cause for mission abort

In Flight

If the [B.O.V.] light is illuminated for more than 3 seconds

- abort the mission
- slow down to a Mach number below 1.4
- set engine power between 6900 and 8100 rpm

Except if absolutely necessary, it is prohibited to run the engine at a power lower than 6900 rpm

If engine power is lower than 6900 rpm, reaccelerate the engine only very slowly

During taxiing, maintain engine power lower than 4000 rpm

If the [B.O.V.] light is illuminated in flight for less than 3 seconds, report the number of such illuminations upon return to base

RPM FREEZING AT LOW VALUE ([OIL] light out) and related JPT

- slow down to subsonic
- descend below 20,000 ft
- throttle : military thrust if throttle movement is possible
- turn the emergency regulation switch on
- actuate the emergency regulation control lever to obtain the desired rpm

The control lever operating limitation in this type of failure is :

between 20,000 and 10,000 ft : rpm < 8500
10,000 and 0 ft : rpm < 8700

If the engine rpm exceeds 9000 in an uncontrolled manner :

- shut down the engine
- retract the emergency regulation actuator (control lever)
- relight following the instructions for relighting in the emergency regulation mode (See para. 4,25.6)

RPM FREEZING AT HIGH VALUE

- slow down to subsonic
- turn the emergency regulation switch on (to open the exhaust nozzle and reduce thrust)
- the emergency regulation control lever has no action to decrease the engine rpm below the frozen value

ENGINE RPM TROUBLES

The engine rpm varies abnormally or drops sharply (by more than 200) with respect to the position of the throttle, or remains low after go-around, with JPT showing the same symptoms

- shut off the AB
- reduce engine rpm

There is a risk of overspeeding and/or thrust surging or loss while continuing flying

If the engine rpm exceeds 9000

- move the throttle to STOP
- relight in the emergency regulation mode (See para. 4,25.6.2)
- use the emergency regulation system (See page 1.25-9, para. 4, SECTION 1)

OVERSPEED SYSTEM DISENGAGEMENT FAILURE or UNTIMELY ENGAGEMENT AT M < 1.4

- shut off the AB
- reduce engine rpm to < 8100

OVERSPEED SYSTEM ENGAGEMENT FAILURE AT M > 1.4

- interrupt the acceleration
- shut off the AB
- slow down to M < 1.4
- check the shock-cone position indicator
  . if it is still reading 1.2 : possible air data computer failure (See para. 4,45.2)

LOW JPT (outside of normal cases, see para. 3,25, SECTION 3)

REMINDER : At high altitude and low speed, a JPT indication of about 550°C may correspond to normal engine operation.

A - Low JPT : 600°C < JPT < 700°C

- turn the JPT emergency regulation switch «OFF»

If the trouble persists :

- do not turn the JPT emergency regulation switch back on at an engine rpm > 8300
- return to base

B - Low JPT : < 600°C

- check that the emergency regulation switch is off (guarded) and the «EM REG» light is out
- check that the throttle has an action on the engine rpm
- at about 10,000 ft, check that the speed can be maintained at military thrust :

(1) i ≤ 7°
- head to the nearest airfield
- do not use the emergency regulation system
- make an emergency regulation type final approach, controlling the engine rpm with the throttle

(2) i > 7°
- jettison the stores
- use the emergency regulation system

EXCESSIVE JPT

- turn the JPT emergency regulation switch off (See NOTE, SECTION 1, page 1.25-8, para. F)
- shut off the AB
- throttle back if possible

Set the JPT emergency regulation switch back to «AUTO» only if JPT < 700°C ; if JPT fluctuations occur, turn the JPT emergency regulation switch off and avoid rpm's between 7200 and 7800.

4.25.3 - AB FAILURES

«INJ» LIGHT FAILS TO ILLUMINATE WHEN THROTTLE IS SET TO AB :

(after the three seconds minimum necessary for the SRL system) OR AFTER ACCIDENTAL AB CUTOUT

- maintain engine rpm between 6900 and 8100

or

«INJ» LIGHT REMAINS ON FOR MORE THAN 10 SECONDS :

(If this failure occurs during takeoff, shut off the AB as soon as conditions permit).

or

AB CUTS IN AND THEN CUTS OUT (within the operating envelope) :

- shut off the AB with the throttle
- DO NOT ATTEMPT TO RE-IGNITE THE AB
- close the AB main cock («MAIN COCK» switch «OFF»)

AB DOES NOT CUT OUT with throttle retarded to military thrust :

- close the AB main cock («MAIN COCK» switch «OFF»)

«SRL» LIGHT ON :

- ignite the AB without using the SRL system (See para. 2,15, SECTION 2)

4,25.4 - SHOCK-CONE FAILURES

(non-agreement between both machmeter readings)

- Utility pressure correct :

- check that the shock-cones are in «AUTO» position (pushbutton depressed)

If the automatic system is no longer serviceable (air data computer failure) :

- correct the shock-cone position manually

- Utility pressure = 0 (the shock-cones remain in the position existing at the time of failure) ;

if the shock-cones are retracted :

- shut off the AB ; decelerate
- reduce rpm carefully
- slow down to subsonic

if the shock-cones are fully or partially extended :

- avoid high engine rpm's in subsonic
- avoid high angles of attack

} be particularly cautious in case of go-around

4,25.5 - COMPRESSOR STALLS

STALL - JPT too high for engine rpm (Engine rpm ∿ 6000, JPT ∿ 600°C, light buffeting)

At altitude :

- move the throttle to idle
- rapidly establish IAS ⩾ 300 kt
- watch JPT : when it returns to normal (∿ 200°C) and buffeting ceases :
  . move the throttle forward
  If the engine accelerates normally, the stall no longer exists.

NOTE : - Above 30,000 ft, the phenomenon may sometimes last more than 30 seconds.
- Below 30,000 ft, if the engine is sound, the phenomenon should cease as soon as the procedure is applied.

Below 30,000 ft, if the phenomenon persists :

- move the throttle to STOP
- be ready for dead-engine landing or ejection after having performed a normal relight procedure

At low altitude, simultaneously :

- pull up smoothly but sharply, wings horizontal, up to IAS : 250 kt
- move the throttle to dry idle
- set the «RELIGHT» switch forward and check it remains in position
- advance the throttle again with caution
- if the phenomenon persists : EJECT

FLAMEOUT :

At altitude :

- carry out normal relight procedure, see para. 4,25.6

At low altitude :

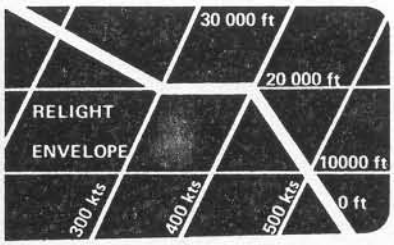
- carry out emergency relight procedure, see para. 4,25.6

4,25.6 - ENGINE RELIGHT

Engine relight instructions are shown on a placard in the cockpit.

FLAME-OUT	RELIGHT	NO RELIGHT
THROTTLE CLOSED	RELIGHT SWITCH ON	RELIGHT SWITCH OFF
I.A.S ≃ 300 kts or	THROTTLE between	Check N and T4
N ⩾ 2600 RPM	FULL DRY and IDLE	THROTTLE CLOSED
AIR-COND. OFF	N > 5000 RPM	TIME = 30 "
DEMISTING ON	T4 < 700° C	TAKE I.A.S. : 230 kts
AT 20000 ft : RELIGHT	RELIGHT SWITCH OFF	or N ⩾ 1100 RPM
		NEW ATTEMPT

MIN AUTO-ROT 1100 RPM
200 kts



Relight Placard

4,25.6.1 - NORMAL

Explanation of instructions :

AFTER FLAMEOUT

- bring the throttle to STOP
- place the aircraft in the relight envelope ; if possible, maintain 300 kt IAS or N ⩾ 2600 rpm to keep the use of the alternators.

Depending on weather conditions :

- turn the air conditioning off
- switch the gyro reference system to emergency
- turn the demisting on.

RELIGHT PROCEDURE

At 20,000 ft :

- place the «RELIGHT» switch in forward position ; check that it remains in forward position (hold it if necessary)
- place the throttle between idle and military thrust
- as soon as engine rpm reaches 5000, watch the JPT which should remain between 250° and 700° C
- turn the «RELIGHT» switch off (although there is a delay of 30 seconds)
- place the throttle in desired position.

IF ENGINE DOES NOT RELIGHT

- bring the throttle back to STOP
- wait 30 seconds and attempt a new relight at a lower altitude
- maintain IAS = 230 kt or N > 1100 rpm
- attempt a new relight.

4,25.6.2 - IN EMERGENCY REGULATION MODE

- Move the throttle to idle
- RETRACT THE EMERGENCY REGULATION ACTUATOR (control lever)
- relight following normal relight instructions
- increase engine rpm with the control lever

4, 25. 6. 3 - EMERGENCY PROCEDURE

If it is necessary to relight in the shortest possible time (low altitude, combat), apply the following procedure :

Simultaneously :

- pull up smoothly but positively, with wings level, until IAS = 250 kt.
- close the throttle.
- place the "RELIGHT" switch in forward position ; check that it stays in this position (if necessary, hold it).
- advance the throttle lever to a position between idle and full power dry.
- jettison external stores.

If the engine is not relit at the end of the pull-up :

- carry out ejection procedures.

WARNING

CRASH LANDING AND DITCHING ARE PROHIBITED

4,25.7 - ENGINE SHUTDOWN INCIDENTS

ENGINE NOT SHUT DOWN BY THROTTLE :

If the engine cannot be shut down (throttle ineffective), shut down the engine by turning the LP main cock switch off.
The engine run-down time will range from 5 to 20 seconds according to the initial engine speed.

ENGINE FIRE AFTER SHUTDOWN :

- restart the engine as soon as rpm $\leqslant$ 1000.
- as soon as rpm reaches 2500, select 7500 rpm until the fire has completely disappeared.
- CHECK THAT THE INFLIGHT RELIGHT SWITCH IS EFFECTIVELY SET TO OFF BEFORE SHUTTING DOWN THE ENGINE.

4,30 - HYDRAULIC SYSTEM

In all cases of failure :

- RETURN TO BASE IN SUBSONIC FLIGHT CONDITIONS
- CHECK THE PRESSURES ON THE HYDRAULIC PRESSURE INDICATOR
- CHECK THAT THE «HYD. P» CIRCUIT BREAKER IS PUSHED IN
- PLAN TO MAKE A LONG FINAL LANDING AS FAR AS POSSIBLE

UTILITY SHUTOFF

Pressure readings Utility = 0
Servo 1 = 210 bar

- if the shock-cones are extended, avoid high engine rpm's in subsonic flight as well as high angle-of-attack maneuvers
- if the shock-cones are retracted, Mach numbers above 1.3 are prohibited
- before extending the U/C in emergency mode
  . select 1/2 flaps
- extend the U/C in emergency mode as per procedure «A» specific to HYD.1 out
  . if the slats lock in the extended position, select full flaps
- if the high-lift devices do not extend :
  . land with i = 11°, IAS { 9 t = 195 kt / 11 t = 215 kt
- deploy the brake chute
- apply the brakes moderately and continuously with the antiskid system on
  if necessary, use the emergency brakes and control the aircraft with the nose wheel steering system
- shut down the engine after clearing the runway, if necessary

HYD.1 light continuously on

Pressures 140 bar < servo 1 < 174 bar E.P. light on or out

0 < utility < 145 bar

Depending on the value of the utility pressure, it will be possible or not to place the shock-cones in a position matching the flight conditions, and to use the utility systems on landing.

- turn the «EL PUMP» switch off ; turn it on again, if necessary

After a short while, HYD.1 + EMG.HYD lights come on + warning horn

then YAW + PITCH + ROLL. + ELEV + RUD lights come on.

Before landing :
In level flight, before extending the elements :
- TURN THE «EL PUMP» SWITCH ON ;
  all the lights should go out, except the HYD.1 light
- reset the servocontrols if necessary
- select 1/2 flaps

If the slats lock down :
- extend full flaps ; otherwise, keep 1/2 flaps
- extend the U/C in emergency mode as per procedure «B» specific to HYD.1 on

On landing :
- deploy the brake chute
- use the normal brakes and the emergency brakes if necessary
- shut down the engine after clearing the runway, if necessary

HYD.2 light on

- check the servo 2 pressure (< 145 bar)
- return to base
- check stick uncouple switch in up position

EMG.HYD light on + warning horn

Check :

- «EL PUMP» circuit breaker pushed in
- «EL PUMP» switch on

EMG.HYD light stays on

- switch off the electric pump and do not use it any more
- return to base

EMG.HYD + E.P. lights on + warning horn

Pressures are normal

Leak in emergency system :

- switch off the electric pump (it can no longer be used)
- watch the servo 1 and «ANC» pressures
- return to base

E.P. light continuously on + warning horn

«SERVO 1» pressure is normal

- test the failure warning panel

If all the other lights are correct and out

- switch off the electric pump (it can be switched back on, if necessary)

HYD 1 + EMG.HYD lights on + warning horn and YAW + PITCH + ROLL. + ELEV + RUD lights on

Pressures 0 < servo 1 < 115 bar
0 < utility < 145 bar

Check :

- «EL PUMP» circuit breaker pushed in
- electric pump on

- if EMG.HYD light goes out, apply same procedure as for HYD.1 failure

- if EMG.HYD light stays on, whether E.P. light comes on or not, apply the procedure applicable to the following failure.

HYD.1 + EMG.HYD + E.P. lights on + warning horn

YAW + PITCH + ROLL. + ELEV + RUD lights also come on

- Return to base in subsonic flight

Pressures $0 \leqslant$ servo 1 $\leqslant 115$ bar
$0 \leqslant$ ancillaries $\leqslant 145$ bar

- switch off the electro-pump
- land according to pressures ; apply at best same procedure as for HYD.1 failure without switching the electro-pump back on

HYD.1 + HYD.2 lights on (engine seizure...)

YAW + PITCH + ROLL. + ELEV + RUD lights also come on

- turn off the «PITCH» and «YAW/ANTI-SLIP» switches
Fly the aircraft smoothly (avoid causing servo 1 pressure to drop below 100 bar) to conditions favorable for ejection ; the E.P. light may come on (in case of engine seizure, the battery endurance about 3 minutes).

HYD.1 + HYD.2 + EMG.HYD + E.P. lights on + warning horn (locking of controls is more or less imminent)

YAW + PITCH + ROLL. + ELEV + RUD lights also come on

CARRY OUT EJECTION PROCEDURES

4,35 - FLIGHT CONTROLS AND FLYING AIDS - AUTOPILOT

4,35.1 - FLYING AID FAILURES

ELEV light on :

- reset with the "SERVO" button.

If this is unsuccessful, the mission can be continued but avoiding high airspeeds at very low altitudes.

PITCH + ROLL. + ELEV lights on :

- check that the "PITCH" switch is on.
- reset with the "SERVO" button.

If this is unsuccessful :

- turn off the "PITCH" switch.

Avoid rough manoeuvres :

- in pitch at high subsonic speeds.
- in roll at high supersonic speeds.

The autopilot can no longer be used.

RUD light on :

- reset with the "SERVO" button.

If this is unsuccessful, the mission can be continued but avoiding high airspeeds at very low altitudes and high roll speeds, especially in supersonic flight.

YAW + ROLL. + RUD lights on :

- check that the "YAW" switch is on.
- reset with the "SERVO" button.

If this is unsuccessful :

- turn off the "YAW" switch : same instructions as when RUD light only is on.

The autopilot can no longer be used.

YAW + PITCH + ROLL. + ELEV + RUD lights on :

- DO NOT RESET : turn off the "PITCH" and "YAW" switches.

If this is unsuccessful, the mission can be continued but avoiding high airspeeds at very low altitudes and high roll speeds, especially in supersonic flight.
The autopilot can no longer be used.

ROLL. light on :

- reset with the "SERVO" button.

If this is unsuccessful, the autopilot can no longer be used.

4,35.2 - ABNORMAL PITCH FORCES

Forces too high :

- select "LOW" ARTHUR.

Forces too low :

- select "HIGH" ARTHUR.

If the anomaly persists : possible dash-pot failure or ARTHUR jamming

- return to "AUTO" ARTHUR.
- avoid high airspeeds and high Mach numbers.

4,35.3 - CONTROL STICK JAMMING (with or without autopilot)

- use the "STICK UNCOUPLE" switch.

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4,35.4 - AUTOPILOT FAILURES

AP light on + warning horn + amber "AP" pushbutton light flashing :

- actuate the autopilot disengage lever (the amber light goes out).

If the AP light goes out, the autopilot can be used again.

AP light on + warning horn + amber "AP" pushbutton light steady on + red "ALT" pushbutton light steady on + red excessive deviation lights steady on :

Autopilot is definitively unserviceable :

- switch the lights off by actuating the autopilot disengage lever.

TRIM light on :

- disconnect the autopilot while holding the control stick firmly ;
  if the failure re-occurs, do not use the autopilot again.

4,40 - HYDRAULIC ANCILLARIES

4,40.1 - HIGH-LIFT DEVICES - AIRBRAKES - SHOCK-CONES

1 - COMBAT HIGH-LIFT DEVICES (Auto)

EXTENSION DOES NOT OCCUR WITHIN ENVELOPE

Check :

- «S/F» circuit breaker
- high-lift device selector switch at «NORMAL»
- combat flap lever extended
- ancillary hydraulic pressure

Auto slats :

- combat flaps can normally be used

Combat flaps :

- combat flap lever retracted
- auto slats can be used

In case of failure of auto slats + combat flaps :

- high-lift device selector switch to «OFF»

RED SLATS-NOT-LOCKED LIGHT ON CONFIGURATION INDICATOR STAYS ON (failure of one droop slat to extend or retract)

- check ancillary hydraulic pressure
- high-lift device selector switch to «OFF»
- high-lift device selector switch to «EMG. RETR», if necessary, then to «OFF»

If unsuccessful :

- limit the airspeed to 440 kt, M = 0.98

S/F light on with or without red slat light on configuration indicator (operation of slotted slat comparator)

- high-lift device selector switch to «EMG. RETR», then to «NORMAL»

If unsuccessful :

- limit the airspeed to IAS = 335 kt, M = 0.85

S/F light on + «LIM» light on + warning horn
then «LIM» light goes out (the flaps retract)

If IAS ∿ 330 kt or M ∿ 0.85

- retract the combat flap lever
- extend the combat flap lever only within the combat flap envelope

S/F light on + «LIM» light on + warning horn

If IAS ∿ 470 kt or M ∿ 1.10

- high-lift device selector switch to «OFF», then to «NORMAL»

If the failure reoccurs, leave the high-lift device selector switch at «NORMAL» only if IAS < 440 kt or M < 0.98

2 - TAKEOFF/LANDING HIGH-LIFT DEVICES (Manual)

LANDING HIGH-LIFT DEVICES FAIL TO EXTEND : the configuration indicator stays out

Check :

- «S/F» circuit breaker
- utility hydraulic pressure
- that the high-lift device selector switch is not at «EMG. RETR» ; S/F light out

If this check confirms the failure :

- slat/flap lever to «IN»
- land without high-lift devices ; $\alpha = 11^{\circ}$

SLATS FAIL TO EXTEND : configuration indicator out

Check :

- «S/F» circuit breaker
- utility hydraulic pressure

If this check confirms the failure :

- land with a maximum of 1/2 flaps ; $\alpha = 11^{\circ}$

TAKEOFF/LANDING HIGH-LIFT DEVICES FAIL TO RETRACT OR RETRACT PARTIALLY ONLY

- do not exceed the airspeed corresponding to illumination of the «LIM» light
- cycle high-lift devices at IAS $\leqslant$ 225 kt
- attempt an emergency retraction

If unsuccessful, return to base for landing :

- if the «LIM» warning light comes on + warning horn at IAS = 225 kt : select full flaps
- if the «LIM» warning light does not come on at IAS $>$ 225 kt : select 1/2 flaps

Take care to observe the alternator limitations (cooling) while holding in these configurations.

S/F light on (operation of slotted slat comparator)

- high-lift device selector switch to «EMG. RETR», then to «NORMAL»

3- AIRBRAKES

Airbrakes fail to extend or retract :

- check ancillary pressure

If correct :

- cycle airbrakes ; leave the control in the retracted position if cycling is unsuccessful

4- SHOCK-CONES : See para. 4,25.4

4,40.2 - U/C, NOSE WHEEL STEERING SYSTEM, ANTISHIMMY SYSTEM, BRAKES

1 - U/C INCIDENTS

RETRACTION INCIDENTS

Control lever jammed in down position, after takeoff :

- maintain IAS < 240 kt - Check that the safety lever is off
- do not use the emergency retraction button (See page 1.40-18, SECTION 1)
  (the position of the shock struts is not known)

Control lever ineffective :

- check the «U/C CONT» circuit breaker

Retraction sequence interrupted :

- set up minimum airspeed (IAS < 240 kt in all cases)
- check the failure warning lights and hydraulic pressures

If a green arrow remains on :

- extend the U/C in the emergency mode as per appropriate procedure (A or B)
- lower the control lever
- burn up fuel
  (to avoid U/C door fatigue, limit use of the airbrakes as far as possible)
- land

In the other cases :

- reset the control lever to the down position as an attempt to extend the U/C and proceed to landing if the U/C locks down

If the U/C does not lock down : extend the U/C in the emergency mode as per appropriate procedure (A or B)

EXTENSION INCIDENTS

Control lever in down position, the sequence fails to take place :

- check the «U/C CONT» and »U/C IND» circuit breakers in
- check the «1 SERVO 2» and «ANC» pressures
- extend the U/C in the emergency mode as per appropriate procedure (A or B)

In all other cases of abnormal indications, if one of the following three conditions applies :

- three green arrows on
- «U/C» warning light (tested before extension) out (rpm < 8100 and IAS < 215 kt)
- U/C down audio signal heard

Landing is authorized without any other action.

Otherwise :

- apply appropriate U/C emergency extension procedure (A or B)

EMERGENCY EXTENSION

A - HYD.1 out

HYD.2 out

SERVO 1 and 2 pressures correct

- Disengage the handle
- After a rotation of 30° (counterclockwise), pull out the handle : the doors open ; wait three seconds (except in case of extreme emergency).
- After an a additional rotation of 60° (counterclockwise), pull out the handle : the U/C extends
- Rotate the handle 30° (clockwise) : the handle locks
- U/C control lever in down position.

The doors remain in the open position (red configuration indicator light on).

- BIP operative.

CAUTION

DO NOT PUSH THE EMERGENCY U/C HANDLE BACK IN ONCE THE U/C IS LOCKED DOWN.

NOSE U/C LEG FAILS TO LOCK DOWN

After one normal extension procedure, completed by an emergency extension procedure, subject the aircraft to alternating load factors in roll ; actuate the airbrakes.

Landing can be effected as follows :

- Make a normal approach with all the flaps available.
- Cut off the antiskid (SPAD) system.
- Deploy the brake chute after touchdown on the main U/C.
- Shut down the engine (close the LP main cock).
- At about 110 kt, bring the nose wheels on ground (control the impact with the pitch control).
- If possible, do not brake except to correct the direction of the aircraft.

ONE MAIN U/C LEG FAILS TO LOCK DOWN

After one normal extension procedure, completed by an emergency extension procedure, subject the aircraft to alternating load factors in roll ; actuate the airbrakes ; increase airspeed to 250/280 kt.

If these actions are unsuccessful :

- Push the emergency U/C handle back fully home.
- Return the U/C control lever to the up position.
- Make new attempts in normal extension mode.
- Make a second attempt in emergency extension mode.

If these actions are unsuccessful :
- Push the emergency U/C handle back fully home.
- Return the U/C control lever to the up position.
- Make a wheels-up landing (See para. 5,25.7, SECTION 5).

If a main U/C leg fails to lock down and retraction is impossible (confirmed by the tower, if possible) :

CARRY OUT EJECTION PROCEDURES.

B - HYD.1 on

SERVO 2 pressure correct and possibility of SERVO 1 and GROUND SUPPORT EQUIPMENT pressure = 0.

CAUTION

ANY LEAK IN CIRCUIT 2 AFTER ONE U/C EMERGENCY EXTENSION MAY RAPIDLY CAUSE TOTAL HYDRAULIC FAILURE.

- Stabilize at a safe height.
- Test configuration indicator lights.
- Check "U/C CONT" circuit breaker in.
- Put or leave U/C control lever in the down position.
- Disengage emergency U/C handle.
- After a rotation of 30° (counterclockwise), pull the handle (the doors open). Wait three seconds.
- After an additional rotation of 60° (counterclockwise), pull out fully the handle (the undercarriage extends).
- As soon as the U/C is locked down (3 green lights + 1 red one), **PUSH THE EMERGENCY U/C HANDLE BACK FULLY HOME.**

The U/C is locked down. The doors remain in the open position. The BIP is operative.

CAUTION

DO NOT ATTEMPT AGAIN EXTENDING THE UNDERCARRIAGE IN THE EMERGENCY MODE.

NOTE : Pushing the emergency U/C handle back ensures hydraulic fluid remains in circuit 2.

NOSE U/C LEG FAILS TO LOCK DOWN

See page 4.40-6.

ONE MAIN U/C LEG FAILS TO LOCK DOW

CARRY OUT EJECTION PROCEDURES.

ONE MAIN U/C DOOR FAILS TO UNLOCK

If the aircraft is in the following configuration :

- U/C control lever in down position
- red light illuminated
- three green lights out

- check "1 SERVO 2" and "ANC" pressures
- check "U/C CONT" and "U/C IND" circuit breakers

If only one main U/C door is confirmed as closed by external check :

- do not extend the undercarriage in the emergency mode
- recycle the undercarriage using the control lever

If only one U/C door is confirmed as closed and "ANC" pressure is still normal :

- place the control lever in the up position
- make a wheels-up landing (See procedure in para. 5,25.7)

or, if a wheels-up landing cannot be performed :

- extend the undercarriage in the emergency mode
- eject after the failure has been confirmed

WHEELS-UP LANDING

See para. 5,25.7.

2 - NOSE WHEEL STEERING SYSTEM

IF THE AIRCRAFT SWERVES DURING TAXIING :

- check the "NOSE" light.

If the light is on :
- cut off the nose wheel steering system
- control the aircraft with the brakes and return to parking area (taxiing under these conditions is less easy).

If the light is out :
- check the rudder trim and, if necessary, cut off the "ANTI-SLIP" system ; if unsuccessful : apply same procedure as above.

"NOSE" LIGHT ILLUMINATED IN FLIGHT :

- cut off the nose wheel steering system
- land with the nose wheel steering system off (steer aircraft with the brakes).

3- BRAKES

«BRAKES» LIGHT ON (Configuration indicator)

On taxiing and on brake release for takeoff :

- throttle back and stop aircraft
- check the parking brake (handle pushed fully home and against the RH stop) and ensure that the brake pedals are not depressed

If the light remains on : cancel the flight

- return to parking area if the engine rpm necessary for taxiing is normal

In flight

Check that the emergency/parking brake handle is pushed fully home.

The «BRAKES» light remains on :

WARNING

DO NOT EXTEND THE UNDERCARRIAGE IN THE NORMAL MODE - EXTEND IT IN THE EMERGENCY MODE.

The «BRAKES» light goes out after the undercarriage has been extended in the emergency mode :

- the three green arrows are illuminated
- the configuration indicator red light is illuminated (U/C doors open)

- perform a normal landing

The «BRAKES» light remains on after the undercarriage has been extended in the emergency mode

- land with the minimum fuel quantity compatible with the weather conditions
- deploy the brake chute upon touchdown (risk of tire bursting)
- control the aircraft with the nose wheel steering system
- brake with the antiskid system
- clear the runway
- shut down the engine and have the aircraft towed

BRAKE TEST ABNORMALITIES

A - U/C UP : the «BRAKES» light fails to come on when one or both pedals are depressed

- turn the antiskid switch off and test the brakes once more

(1) If the light comes on when each pedal is depressed :
  - turn the antiskid switch back on (guarded) and land normally

(2) If the light comes on when only one pedal is depressed, or does not come on :
  - perform a precautionary landing in the middle of the runway
  - deploy the brake chute
  - the emergency brakes may be used carefully (antiskid system inoperative) and the aircraft steered with the nose wheel steering system

B - U/C DOWN : the «BRAKES» light comes on when both pedals are simultaneously depressed

- successively retract and extend the U/C

If the failure persists :

- turn the antiskid switch off
- use the brake chute
- apply the brakes moderately (antiskid system inoperative)

UTILITY PRESSURE = 0

- use the normal brake system with the antiskid system

then, if necessary :

- use the emergency brakes and the nose wheel steering system

4,40.3 - BRAKE CHUTE

OPENING INCIDENTS

On landing :

- keep the nose high until braking initiation speed is reached

On go-around :

- push the brake chute control back fully forward
- perform a normal go-around

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4,45 - FLIGHT INSTRUMENT SYSTEMS

4,45.1 - HEADING AND VERTICAL REFERENCE SYSTEM AND STANDBY HORIZON

1 - SPHERICAL INDICATOR MALFUNCTION with or without flag :

- check the "GYRO" circuit-breaker.
- check the "GYRO" INDICATOR

If it reads "ON" : the spherical indicator only is defective :
- set the "N/P" selector switch to "P" (the crossed pointers remain available).
- fly aircraft using the standby horizon.
- the heading is read on the navigation indicator and the sight.
- the autopilot remains usable.

If the indicator shows ▨ : the gyro system is defective :
- select "EMG".
- do not cut off the gyro system unless the spherical indicator fluctuates violently.
- set the "N/P" selector switch to "P".
- fly aircraft using the standby horizon.
- the emergency heading is available on the navigation indicator.
- the autopilot can no longer be used.
- the sight attitude reticle is biased out of view.

2 - "HDG" FAILURE INDICATOR shows ▨ :

- make a resetting on "MH"; if unsuccessful :
  - set the heading selector switch to "EMG".

A - The failure indicator returns to "ON" : the heading is correct on the spherical indicator and on the navigation indicator.

B - The failure indicator remains on ▨ : read the emergency heading on the navigation indicator.

The spherical indicator remains usable for attitude indications.
The autopilot disengages, or cannot be engaged.

3 - "EMG HDG" POINTER offset on emergency gyromagnetic compass :

- Blip the selector switch to "ERECT".

4 - STANDBY HORIZON FLAG VISIBLE :

- check that the switch is set to on.
- check that the standby horizon is uncaged.
- if failure persists : turn the standby horizon switch off and cage the instrument.

4, 45. 2 - AIR DATA SYSTEM

PITOT light on :

- check that the probe heater switch is set to on.
- avoid icing areas (fly at IAS > 350 kt).

ADC light on :

In supersonic flight

- manually adjust the shock-cone position according to the Mach number.

If the overspeed system does not operate, limit the airspeed to M < 1.4.
If it cuts out : decelerate to M < 1.4.
At altitudes below 27, 500 ft (standby altimeter reading) :
if the slaved altimeter indicates an altitude higher than 27, 500 ft, do not use max. A/B.

In all types of flight

The ARTHUR selector switch may be used to match the pitch control forces with the flight conditions.

CAUTION

SET THE HIGH-LIFT DEVICE SELECTOR SWITCH TO "OFF".

The slat/flap lever remains operative and will be used for the approach.

4, 45.3 - MISCELLANEOUS INSTRUMENTS

1 - INCIDENCE INDICATOR

Flag visible :

- disregard incidence indicator readings.

See para. 5, 25. 5, SECTION 5.
Eventually use velocity vector.

2 - SLAVED ALTIMETER

Flag visible :

- use the standby altimeter.

4,55 - PILOT'S EQUIPMENT AND ASSOCIATED SYSTEMS

4,55.1 - EJECTION SEAT - ESCAPE FROM AIRCRAFT

1 - ON THE GROUND

- lower the helmet visors
- open the quick-release box
- unfasten the survival pack lowering line
- unlock the free part of the personal equipment connector (this releases the leg restraining straps)
- open the canopy

If the canopy fails to open :

. embrittle the canopy with the canopy embrittle lever : To break the canopy after embrittlement, proceed as follows : successively strike the sides of the canopy with the left and right elbows, then strike the upper part of the dome with both fists or the head.

If canopy embrittlement fails :

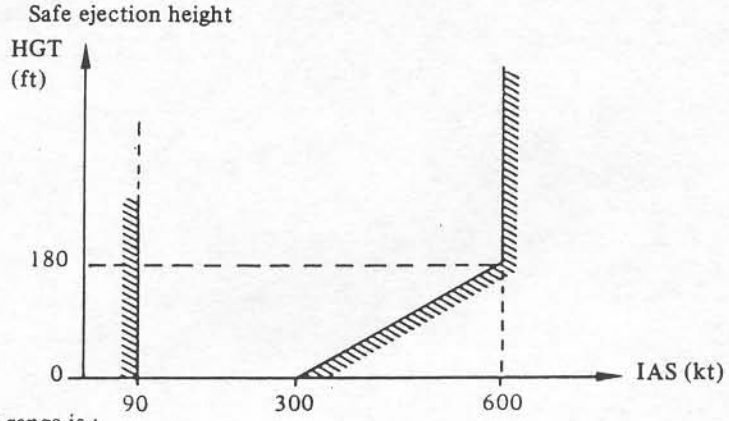
. use the canopy shear knife : Strike the canopy above the head and as far to the rear as possible ; the canopy starts showing star-shaped cracks.
Strike each plexiglas panel in the center, at about 10 cm from the edge.

- abandon the aircraft

2 - IN FLIGHT

- EJECTION ENVELOPE :

The ejection envelope in straight and level flight is given by the following curve :



When HGT = 0, the speed range is :

90 kt $\leqslant$ IAS $\leqslant$ 300 kt

At the maximum permissible seat ejection speed of 600 kt, the minimum safe ejection height is :

HGT = 180 ft

Above 30,000 ft, the seat ejection limit is :

Mach 1.5

Physiological Risks

Beyond 450 kt, the risks of serious bodily injuries become important.

Ideal Ejection Conditions

IAS = 250 kt HGT = 10,000 ft

With wings level and slightly ascending flightpath

Falling Time

Seat stabilized : from Hp = 50,000 to 11,500 ft : 3 min 15 s approx

Chute open : from Hp = 11,500 ft to 0 : 8 min 30 s approx

EJECTION PROCEDURE

- move the throttle to STOP (if possible)
- lower the helmet visors
- fully pull the face blind firing handle (or alternative firing handle) of the seat, keeping the elbows tight against the body and the head against the seat cushion

The canopy is immediately embrittled, the seat is fired instantaneously and passes through the canopy (the upper reinforcements of the seat breaking the canopy).

AFTER EJECTION

- ensure that the survival pack lowering line is secured to the pilot

In the last 500 meters before reaching ground or water :

- release the pack by pulling on the elastic section of the lowering line. The dinghy inflates and remains attached to the lowering line

If the pack fails to fall, it can be released by simultaneous action on the two lateral quick-release fittings.

OVER GROUND

- on reaching the ground, get rid of the parachute by opening the quick-release box

OVER WATER

- undo the oxygen mask
- inflate the life jacket
- on reaching the water, release the quick-release box
- haul the dinghy by pulling on the lowering line
- board the dinghy from the narrow end
- haul the kits attached to the lowering line on board

CAUTION

IN CASE OF EJECTION AT VERY LOW ALTITUDE, DO NOT FORGET TO RELEASE THE SURVIVAL PACK IMMEDIATELY AFTER PILOT'S PARACHUTE OPENING. OTHERWISE, THE PILOT MAY BE SERIOUSLY INJURED ON REACHING THE GROUND.

3 - INSTRUCTIONS FOR PLANNED EJECTION FROM CONTROLLABLE POWER-ON AIRCRAFT

- fly to the specified ejection area prepared as per PFOI (Provisional Field Operating Instructions)
- maintain the aircraft at an altitude between 5000 and 10,000 ft
- disconnect the autopilot, if no failure prevents such an action, to keep control of the aircraft
- trim the aircraft for level flight or slight nose-up attitude at a speed of about 250 kt
- throttle back and eject immediately

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EMERGENCY PROCEDURE

- THE FACE BLIND FIRING HANDLE FAILS TO OPERATE:

- actuate the alternative firing handle.

- NEITHER CONTROL OPERATES :

- descend to 15, 000 ft, if possible (oxygen).
- pull the first D-ring (RIGHT HAND).
- actuate the manual override lever (LEFT HAND).
- embrittle the canopy by pushing forward the canopy embrittle control.
- roll the aircraft into the inverted position (trim forward).
- bail out.
- pull the second D-ring (RIGHT HAND) during the free fall.

- THE STABILIZER DROGUE FAILS TO OPERATE :

The pilot and the seat spin in all directions.

- immediately pull the first D-ring (RIGHT HAND)
  (If this is not done, the seat will entangle with the pilot's parachute on opening).

The pilot then has two possible courses of action :

(a) Above 15, 000 ft :
- wait for automatic separation to occur at 15, 000 ft.

(b) Below 15, 000 ft, or if automatic operation is doubtful :
- operate the manual override lever (LEFT HAND).
- push away the seat to get free (spring clips).
- pull the second D-ring (RIGHT HAND).
  (in this case, parachute opening is not automatic).

WARNING

IT IS ESSENTIAL THAT THE FIRST D-RING SHOULD BE PULLED IMMEDIATELY BY THE PILOT WITH THE RIGHT HAND ; OTHERWISE THE TIME RELEASE MECHANISM MAY OPERATE BEFORE PILOT'S PARACHUTE/ STABILIZER DROGUE SEPARATION HAS OCCURRED.

THE PILOT/SEAT SEPARATION TAKES PLACE ; THE PILOT'S PARACHUTE DEPLOYS FIRST, CAUSING A REVERSE SEQUENCE. THE SEAT REMAINS CONNECTED TO THE ASSEMBLY BY THE DROGUE PISTON.

CONTACT WITH THE GROUND IS VERY DANGEROUS.

4, 55. 2 - OXYGEN

NO INDICATION (pressure, blinker, position, lights and warning horn) :

- check the "OX" circuit-breaker.

Ox REG light on + warning horn :

- breathe deeply.

If unsuccessful

- turn the selector switch to "EMG" (the position repeater magnetic indicator changes to red).
- return to base.

The flow indicator (blinker) is lost ; the white square is visible
- the **Ox REG** light goes out and becomes meaningless
- the warning horn stops operating.

5mn Ox light on :

- check the oxygen gauge and perform a test :
  - descend rapidly below 12, 000 ft cabin altitude.
  - cancel the flight.

PHYSIOLOGICAL TROUBLES FELT WITHOUT ILLUMINATION OF **Ox REG** LIGHT

In case of troubles felt by the pilot, the latter will turn the selector switch to "100 %" and depress the oxygen overpressure button.

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4,55.3 - AIR CONDITIONING

CAB.P light on + warning horn
or
pressurization fluctuations :

- check the «CAB P» circuit breaker
- compare the cockpit altitude with the aircraft altitude
- check :
  . canopy closed and locked
  . canopy seal valve control lever full forward
  . ram air switch off (guarded)
  . master valve control switch on

If the failure results from an oversight, before correcting it :

- reduce engine rpm

If a failure has occurred, descend to H < 20,000 ft.

CAB.T light on + warning horn :

- set the temperature control rheostat to «MANUAL»
- blip control in «COLD» direction
- watch the solenoid valve position indicator

If the valve does not move (observe the position indicator) :

- check the «CAB T» circuit breaker

If the temperature is correct :

- try to switch back to «AUTO»

If unsuccessful :

- set the emergency cold switch to «EMG COLD»
  If necessary :
  . master valve control switch «OFF»
  . canopy seal valve control lever fully aft
  . ram air switch on at H < 10,000 ft and IAS < 450 kt

EQ.T light on :

Check the temperature indicator to determine the type of warning (too hot or too cold) :

- switch the «AUTO/MANUAL» selector switch to «MANUAL»
- actuate the valve through the control switch to bring the temperature to the desired range

If the preceding operations are unsuccessful (mechanical valve jamming) :

- reduce engine rpm if conditions permit
- turn the master valve control switch off
- descend to an altitude lower than 20,000 ft
- if necessary, use the ram air control switch (H ⩽ 10,000 ft - IAS ⩽ 450 kt)

CABIN MISTING

Try, in the following order :

- demist switch forward.
- temperature control rheostat to 3 or 4 o'clock.
- full "MANUAL HOT".
- air conditioning master valve control switch "OFF".
- canopy seal valve control lever fully aft.
- ram air switch on.

Once these operations have been completed, avoid flying over 20, 000 ft.

CABIN SMOKES

Carry out the following :

- pressurization master valve control switch "OFF".
- canopy seal valve control lever fully aft (deflation).
- ram air valve switch on.
- oxygen on 100 %.
- depress the oxygen overpressure button.

Once these operations have been completed, avoid flying over 20, 000 ft.

4,55.4 - CANOPY OPENING, LOSS OR BREAKING

Apply the following procedure :

- check helmet visor down
- seat in down position
- if Hp > 30,000 ft : oxygen to positive pressure
  if Hp > 20,000 ft : oxygen to 100%
- return the aircraft to IAS < 250 kt and Hp < 10,000 ft to reduce turbulence and noise
- perform straight-in approach
- final speed 10 kt higher than normal speed

4,60 - FIRE

1 - FIRE ON STARTING

A - «ENG» and/or «AB» Fire Warning Lights On + Warning Horn

- throttle to STOP
- LP main cock switch off
- LP pump switches (all three) off

In case of emergency

- turn off the «BATT» and «ALT» switches
- abandon the aircraft

B - Smoke Coming out of Intake Ducts (signaled by ground crew)

- interrupt start

Smoke disappears, and ground crew has not detected any odor characteristic of electrical fire :

- attempt a new start, mandatorily applying the instructions for downwind start (See page 4.25-3)

Smoke persists : do not attempt a new start

C - Fire in AB Duct, Signaled by Ground Crew

JPT $> 900^{\circ}C$

- throttle to STOP
- LP main cock switch off
- LP pump switches (all three) off
- ignition/ventilation selector to «VENT»
- cancel the mission

JPT $< 900^{\circ}C$

- as soon as rpm reaches 2500, select 7500 rpm until fire is completely out
- check that the relight switch is off
- throttle back to idle rpm

If, after ground crew check, the pilot has to shut down the engine :

- accelerate up to 7500 rpm
- LP main cock switch off
- LP pump switches (all three) off
- battery switch off

2 - FIRE ON TAKEOFF

See para. 4,10.1

3- FIRE OUTSIDE OF TAKEOFF (Hp ≥ 1500 ft - IAS ≥ 250 kt)

«ENG» and/or «AB» light(s) on + warning horn

- shut off the AB
- close the AB main cock
- reduce engine rpm
- look for signs of fire : JPT, smoke trails in turns, smoke in the cockpit, etc.

If the fire is confirmed :

- move the throttle to STOP

CARRY OUT EJECTION PROCEDURES

If the fire is not confirmed :

- land immediately, shut down the engine after clearing runway

CAUTION

THE ILLUMINATION OF A FIRE WARNING LIGHT, FOLLOWED BY ITS EXTINCTION, CAN INDICATE A VERY FIERCE FIRE : DESTRUCTION OF THE WARNING LIGHT POWER SUPPLY CIRCUIT.

SECTION 5

FLIGHT CHARACTERISTICS
EXTREME WEATHER OPERATION

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5,10 - HIGH ANGLES OF ATTACK - SPINS

5,10.1 - GENERAL

- The information and instructions given in this chapter result from aircraft flight tests.
- Since all encountered phenomena cannot be described, it is advisable to attend the projection of instruction films made about this subject.

5,10.2 - COORDINATED-FLIGHT ANGLE-OF-ATTACK LIMITS

1- GUN FIRING LIMITS

The gun firing limits are essentially imposed by slight rolling tendencies and a high maneuverability reduction in roll, which may affect sighting ; this phenomenon appears at the angles of attack shown in the diagram below.

NOTE : With combat flaps, the limit is equal to the maneuvering limit, i.e., i = 17°.

2- MANEUVERING-FLIGHT ANGLE-OF-ATTACK LIMIT

The 17° maximum permissible angle of attack has been established by considerng the most unfavorable case. The criterion retained is the margin relative to control loss. The actual limit, i.e., that beyond which control may be lost, also appears in the diagram.

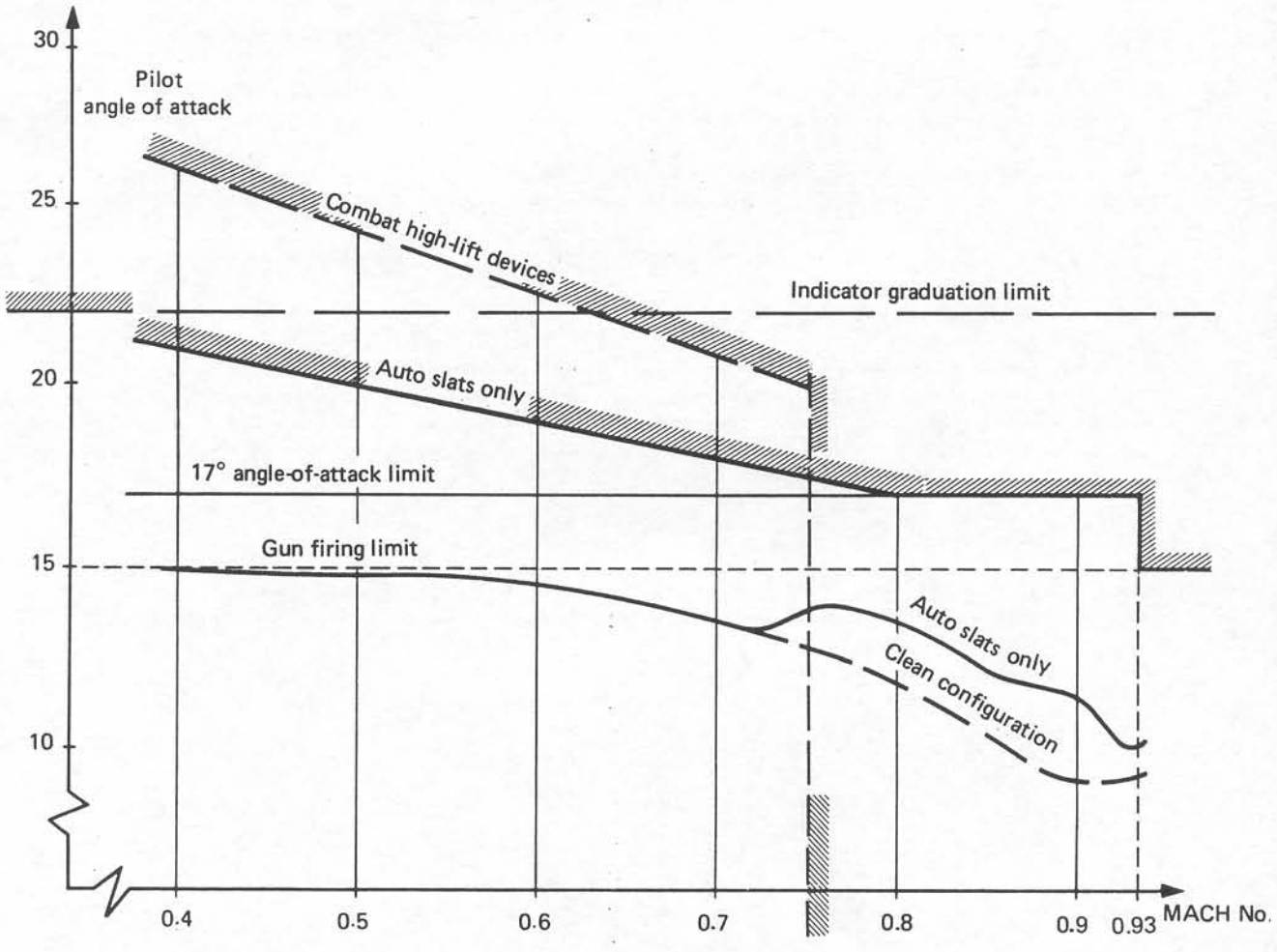


FIGURE 1 – ANGLE OF ATTACK VERSUS MACH NUMBER BEYOND WHICH CONTROL MAY BE LOST

5,10.3 - AIRCRAFT BEHAVIOR AT HIGH ANGLES OF ATTACK

The aircraft behavior at high angles of attack is very sound. The 17° permissible limit is easily exceeded unless the angle-of-attack indicator is watched, the control forces on the control stick are very light and the buffeting level is low and constant. The control stick is often pulled up to the pitch travel limit without any obvious anomaly, specially with the combat flaps extended.

CAUTION

IT IS THE SIDESLIP WHICH INDUCES THE LOSS OF CONTROL ; THE PRESSURE ON THE CONTROL STICK SHOULD THEREFORE BE SLIGHTLY RELEASED JUST AS THE NOSE STARTS SWERVING OR THERE IS A TENDENCY TO REFUSE TO TURN.

AS MUCH AS POSSIBLE, AVOID USING THE ROLL CONTROL WHICH IS THE MAJOR CAUSE OF SIDESLIP. TURN REVERSAL IS MUCH FASTER AND SOUNDER BY APPLYING RUDDER ONLY.

Remember that beyond 20° nose up, the lift coefficient no longer increases and that pulling the control stick farther aft will only result in increasing the drag and not the rate of turn.

Effects of combat flaps :

The combat flaps increase the lift by 25% up to about 18° nose up and set back the control loss limit by 4° to 6° at low Mach numbers. However, they induce uncontrollable sustained wing rocking at about 20° to 22° nose up, which is unpleasant though not hazardous.

Effects of AIR-TO-AIR stores :

- with 530 belly missile, the aircraft becomes more sensitive in yaw at i = 17° and beyond. When using only the rudder for lateral control, the same angle-of-attack limits are attained
- the wing tip missiles improve the lateral behavior as do the combat flaps. By combining both of them, it becomes possible to make maneuvers with the control stick full aft but however with the aircraft angle of attack not exceeding 25° to 30° nose up
- asymmetrical missile loading : with only one wing tip missile, the opposite wing is heavy and conversely with a single 530 missile. It will therefore be easier to reverse the turn away from the wing tip missile or toward the 530 missile, as applicable.
  By applying roll control only to balance the heavy wing, the aircraft angle of attack can be increased up to the same limits

Configurations with pylon tanks :

The cases of control loss or spin in these configurations have not been experimented in flight.
However, it should be noted that the presence of a belly tank reduces aircraft lateral stability, which may entail great sideslips. Consequently, it is strongly unadvisable to perform maneuvers liable to entail great sideslips at the angle-of-attack limits indicated in paragraph 5,10.2 since, in these conditions, it is difficult to maintain coordinated flight (high-amplitude roll control deflection, turn reversals, fast maneuvers).

High angles of attack at low speed :

If, at low speed, the angle of attack reaches high values, for instance, level flight with insufficient engine power, the aircraft sinks and roll control is less and less effective. The reflex actions to recover from such a condition should be as follows :
- select MAX AB + combat flaps
- smoothly release back pressure on the stick without counter action in roll
- pull up smoothly as soon as the angle of attack comes back to normal values.

5,10.4 - CONTROL LOSSES, SPINS

These are the results of an excessive sideslip either following a violent break with a very steep peak angle of attack, or because of a large roll control deflection at high angles of attack. A high yaw rate is then established, this is the stall.

GENERAL CASE

The aircraft describes a fan-shaped movement, i.e., a spinning turn about its initial trajectory. If the pilot releases the controls without delay, the rotation stops within 1/2 to 2 turns and the nose drops rapidly ; the final attitude is usually 30° to 90° nose down with shallow residual oscillations and very often a rolling motion at a variable rate which does not last (two rolls maximum) ; this should not be confused with a spin : look at the ASI which should indicate an increasing airspeed ; at 200 kt, the pilot can use the controls again.

OTHER TYPICAL PHENOMENA

(1) Very often, specially when the stall is very severe, which happens at transonic speeds for instance with the flaps retracted, violent rotations in pitch are also encountered together with changes of yaw and roll directions. These combined movements are very likely to cause disorientation and the pilot is strongly shaken (helmet hitting the canopy) : this is what is designated by the term «tossing» which is typical of present-day aircraft. The pilot exposed to these phenomena has nothing else to do except to wait while watching the altimeter with the controls released and he thinks that time goes by very slowly. The preliminary signs of the recovery are the average nose-down attitude becoming increasingly steeper and the mean airspeed which builds up. Generally, everything abates rapidly and suddenly : glance at the ASI (~ 200 kt) and pull out.

(2) Self-Rolls : These are very fast owing to the IAS (up to 350°/s at 190 kt) and they occur in two cases :

- following a corrective action by pushing the control stick fully forward
- following a corrective action in roll with the control stick pulled aft and with a negative angle of attack in this case.

This phenomenon may be hazardous. These rolls are always stopped very quickly by releasing the control stick. They occur more often when there are no stores. Above all, do not attempt to counteract using the roll control as this action can have only one result : to make the phenomenon worse since the roll rate increases rapidly.

(3) Asymmetrical Stores

These configurations are usually much more severe, specially in the asymmetrical R 530 missile configuration. If the aircraft enters a spin with the missile on the outside of the turn, which happens when roll control is applied on the same side as the missile, a high rate of rotation and a spinning phase known as «flat and fast» spin are rapidly established : the nose remains rather high (if the spinning axis is vertical) and, above all, the pilot is violently pulled forward (2 to 4 g's) and has difficulties in raising his head.

This phase may last for up to 10 seconds even though the controls have been reset to neutral.

Afterwards, the aircraft enters the phase of tossing of very large amplitudes (± 90° pitch attitudes are easily encountered in one second) which can have the same duration. The evolution toward the recovery occurs as in (1), except that the time required may attain 20 seconds (See para. 5).

(4) Inverted Positions - Inverted Spins

The aircraft passes quite often in inverted positions during the tossing either in pitch (such as «tilting on the nose») or simply in roll. Most often, the aircraft does not remain in the inverted position.

The aircraft may however continue in an inverted spin, specially when the pilot has kept some pressure on a rudder pedal and even though he has neutralized all the controls afterwards : this is the only spin case which is likely to last and which requires a positive action : full opposite rudder (i.e., in the direction opposite to the movement of the nose on the landscape).

CAUTION

THE RUDDER ACTION IS NOT ALWAYS IMMEDIATELY EFFECTIVE. 5 TO 6 SECONDS MAY BE NECESSARY BEFORE THE ROTATION BEGINS TO SLOW DOWN.

IDENTIFYING THE INVERTED SPIN : THE PILOT IS HANGING IN THE SHOULDER STRAPS, THE MASTER WARNING HORN OPERATES PERMANENTLY (OIL FAILURE), THE ROTATION IS CONSTANT. NO MORE ANGLE-OF-ATTACK LIMIT INDICATION, WHEN THE PILOT RAISES HIS HEAD HE SEES NOTHING ELSE BUT THE EARTH, THE ANGLE-OF-ATTACK INDICATOR IS IN THE NEGATIVE LIMIT POSITION.

NOTE : During a flight test, one case of inverted spin has been encountered which occurred immediately after neutralizing the controls following a simple stall ; the pilot should therefore be prepared to apply the double instruction : release all controls and then, if necessary, apply opposite rudder if an inverted spin is clearly identified.

- Summary table of effects of the various parameters :

Alleviating effect : aircraft more reluctant at the start and then slower rotations, pilot less shaken, faster recovery.

Aggravating effect : the inverse.

Alleviating	Aggravating
- Combat flaps	- Asymmetrical stores
- Wint tip missiles	- Airbrakes
	- Opposite pitch or roll control

(5) Losses of Altitude

The initial flightpath in the vertical plane has a great influence : at the extreme, a short loss of control in a steep climb does not cause any loss of altitude. The figures given are applicable to a loss of control occurring in a level turn. This is an average established through testing and including the recovery (starting altitudes between 30,000 and 50,000 ft).

clean or symmetrical stores	auto slats only	8 to 15,000 ft
	combat flaps	6 to 14,000 ft
asymmetrical stores	auto slats only	10 to 20,000 ft
	combat flaps	8 to 14,000 ft

(6) Trims

- Pitch :
The «control stick released» instruction has been verified with the trim at normal flight settings, i.e., zero index at mid-travel in the nose-up direction (pitch control between – 1° and – 8°).

Similarly, it has been ascertained that, in a fast spin, the control stick when also pushed forward did not induce a nose-down pitch control deflection jeopardizing the recovery.

NOTE : No test has been conducted with a nose-up trim setting.

In all cases, after the rotation has stopped, the recovery must be controlled in relation to the angle of attack.

- Roll - Yaw :
For the asymmetrical configurations, the instruction has been verified with the aircraft trimmed. This does not usually exceed the thickness of the index, and trim reset to zero to simulate the case of a loss of control occurring immediately after launching of a wing missile (with two missiles initially). The antislip system is not disturbing.

(7) Engine

Statistical results covering all the tests performed (% of cases, starting at H ≥ 30,000 ft).
50% : nothing to report.
36% : partial compressor stall (with possibility of exceeding the JPT limit).
14% : sharp flameout.

REMARK :
At a given Mach number, the influential parameter is the equivalent angle of attack, i.e., the angle between the velocity vector and the aircraft centerline, which therefore is a combination of the angle of attack and sideslip. The possibilities of engine malfunctions increase as the Mach number.
The engine speed has no influence in so far as it is stable. The AB is not an aggravating factor. However, it is recommended that the AB should be shut off and the power setting reduced as soon as possible to minimize possible overheating. The altitude has an indirect influence ; it has been noticed that the engine troubles were more numerous above 35,000 ft.

(8) Autopilot

In the case of a control loss with the autopilot disconnected, the angular velocity safety devices (See NOTE) and the altitude safety device prevent reconnection before control is effectively recovered. Also, in many cases, one or more dampers pop out, which makes any connection attempt unsuccessful.

NOTE : Very low values as compared with those reached during a loss of control : roll ± 30°/s
pitch ± 9°/s

5,10.5 - SUMMARY OF INSTRUCTIONS

1 - CONTROL LOSSES - SPINS

(1) RELEASE THE CONTROLS, INCLUDING THE RUDDER PEDALS.

(2) Shut off the AB, reduce engine rpm, retract the airbrakes.

(3) Watch the airspeed and the altitude (standby altimeter in case of engine flameout).

At an increasing airspeed of 200 kt, the aircraft is no longer spinning. Counteract any residual roll movements and start pulling out smoothly.

2 - INVERTED SPINS : UNMISTAKABLY IDENTIFIED

The inverted spins are recognized by the fact that the rotation is constant, the Earth is above and the pilot is hanging in the shoulder straps. There is no more audio warning for the angle of attack but the master warning horn is operating (OIL light illuminated).

(1) Release the control stick (pitch and roll neutralized).

(2) Apply full rudder (in the direction opposite to the movement of the nose on the landscape).

(3) Neutralize rudder as soon as rotation stops.

WARNING

MANDATORY IN ALL CASES : IF CONTROL IS NOT RECOVERED AT 10,000 ft, EJECT

- STORE JETTISON PROHIBITED
- BRAKE CHUTE OPENING PROHIBITED

CAUTION

IN CASE OF SELF-ROLLS :
- DO NOT APPLY OPPOSITE ROLL CONTROL
- CHECK THAT CONTROL STICK IS NOT PUSHED FORWARD

5, 25 - SPECIFIC LANDINGS

GENERAL

Reference to "normal landing pattern" means that reference should be made to the normal procedures. It is clearly understood that the more a landing is going to be difficult the more it is important to observe the specified instructions.

5, 25. 1 - LANDING FOLLOWING CLOSE FORMATION FINAL

- the leader final is flown at an incidence equal to an individual final.
- the leader brings his wingman to a point 100 m (330 ft) from runway threshold with a slight step-up and announces "take over for landing - incidence .....".
- the wingman takes over for landing and lands in the normal manner.
- the leader, on the other hand, maintains his power setting for 3 seconds after touchdown.
- flare-out and touchdown are made individually in the centre of each half-runways.

5, 25. 2 - SHORT LANDING

- Normal landing pattern.
- On final, aim for a point definitely before the desired touchdown point (300 m - 1000 ft approximately).
- Flare out without throttling back so as to come in level flight very close to ground - i = 11 to 12°. Lengthen the approach by adding power if necessary.
- When landing at desired spot is assured, throttle back and land the aircraft ; deploy the brake chute immediately after throttling back.

CAUTION

THESE THREE ACTIONS ARE PRACTICALLY SIMULTANEOUSLY ACCOMPLISHED AND CALL FOR CORRECT EVALUATION OF THE HEIGHT ABOVE THE RUNWAY THE MOMENT THE DECISION IS MADE.
- DO NOT ATTEMPT TO ESTABLISH AN EXCESSIVELY LOW IAS BY HOLDING OFF : THE PRECISION OF THE TOUCHDOWN POINT AND THE SIMULTANEOUS DEPLOYMENT OF THE BRAKE CHUTE ARE THE MOST IMPORTANT FACTORS.

- Immediately bring the nose wheel on ground and use maximum braking after checking the IAS (which should normally not exceed 120 kt at this stage).

NOTE : For demonstration purposes, this type of landing can be preceded by a tighter pattern with a pre-touchdown level flight leg as short as possible. Special training is absolutely necessary.

5, 25. 3 - FLAP FAILURES (landing with 1/2 flaps or without flaps is indifferently considered, the slat position being negligible)

- Normal landing pattern.
- Recommended incidence on final : 11°, which gives :

9000 kg = 195 kt 11, 000 kg = 215 kt	clean
9000 kg = 165 kt 11, 000 kg = 180 kt	1/2 flaps

- Throttle back after touchdown ; deploy the brake chute.
- Apply the brakes as required.

5,25.4 - FLAMEOUT PATTERN

- As soon as possible, check :

- electric pump switch	: on
- undercarriage	: down
- «SLATS/FLAPS» selector switch	: «OFF»
- combat flap lever	: in
- «PITCH» switch	: off
- «YAW/ANTI-SLIP» switch	: off

The configuration is then :

U/C DOWN
IAS = 230 kt
DAMPERS OFF

CAUTION

1. AIRSPEED OF 230 kt HAS BEEN RETAINED TO MAINTAIN SUFFICIENT ENGINE WINDMILLING SPEED (DRIVING OF HYDRAULIC PUMPS).
2. IN MANEUVERING FLIGHT, ANGLE-OF-ATTACK LIMIT IS EASILY ATTAINED ($i = 17°$).

- Final glide slope = 700 ft/1000 m (12° approx.)
  R/D = 4500 ft/min
  minimum altitude for ejection decision : 1500 ft

- It can be seen from the final approach sectional view that a horizontal distance of 1000 m is required for the flareout completed at 210 kt and that an additional distance of 1000 m is required to touch down at 160 kt IAS. A point definitely before runway threshold should therefore be aimed at (400 m). The flareout should be smooth and continuous so as to be completed very close to the ground at a comfortable IAS. Determination of the touchdown IAS is then a matter of compromise between remaining runway length and brake chute resistance.

- If necessary, extend 1/2 flaps upon initiation of the flareout (not before) to lengthen the approach by about 400 m.

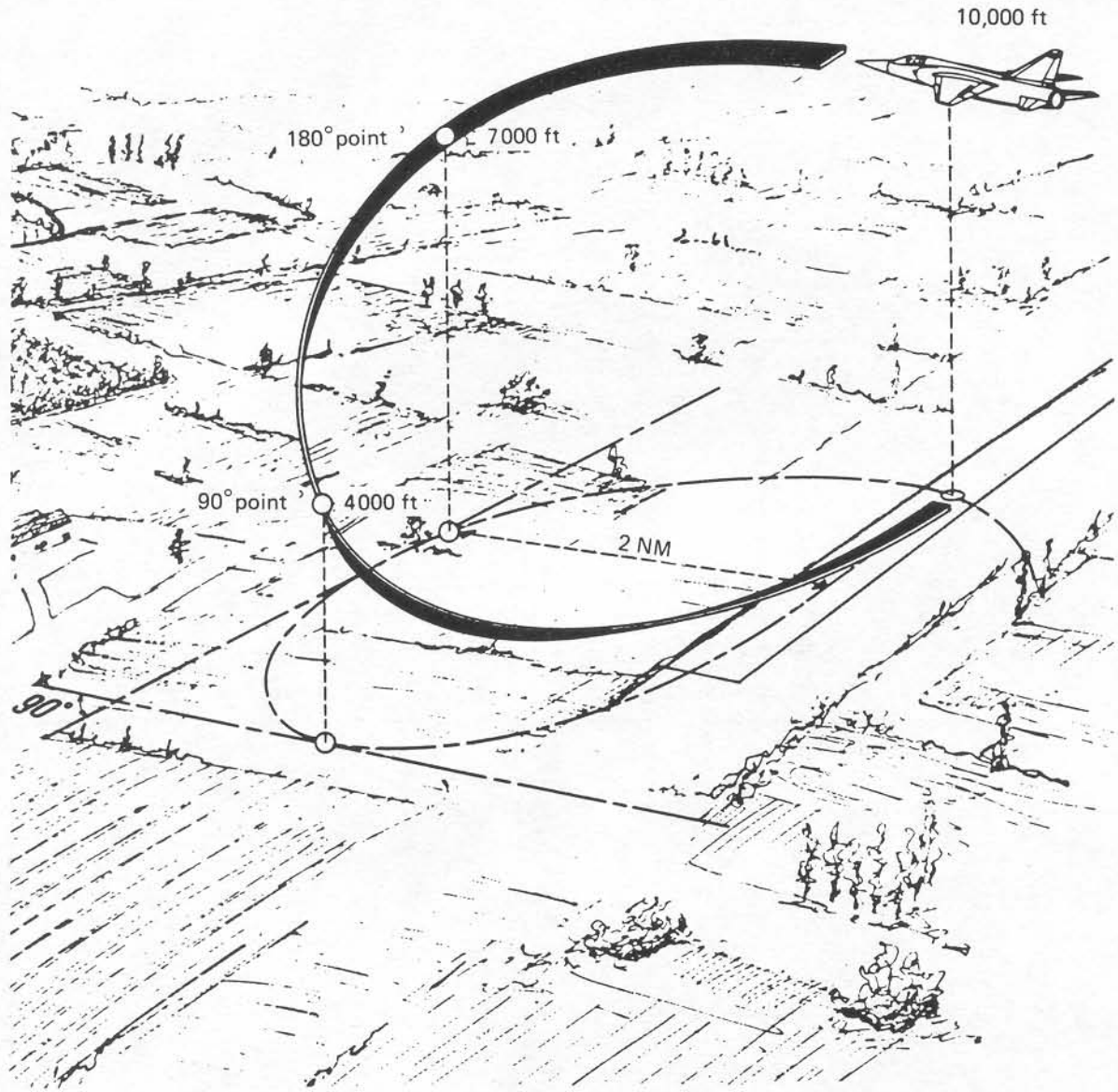
NOTE : - Flap extension time under these conditions is about 10 seconds.
- Retracting the slats reduces the drag at low angles of attack.
- Switching the dampers off reduces the hydraulic load.
- The relight sequences do not require a large amount of energy ; relight should therefore be attempted, even after entering the flameout pattern.

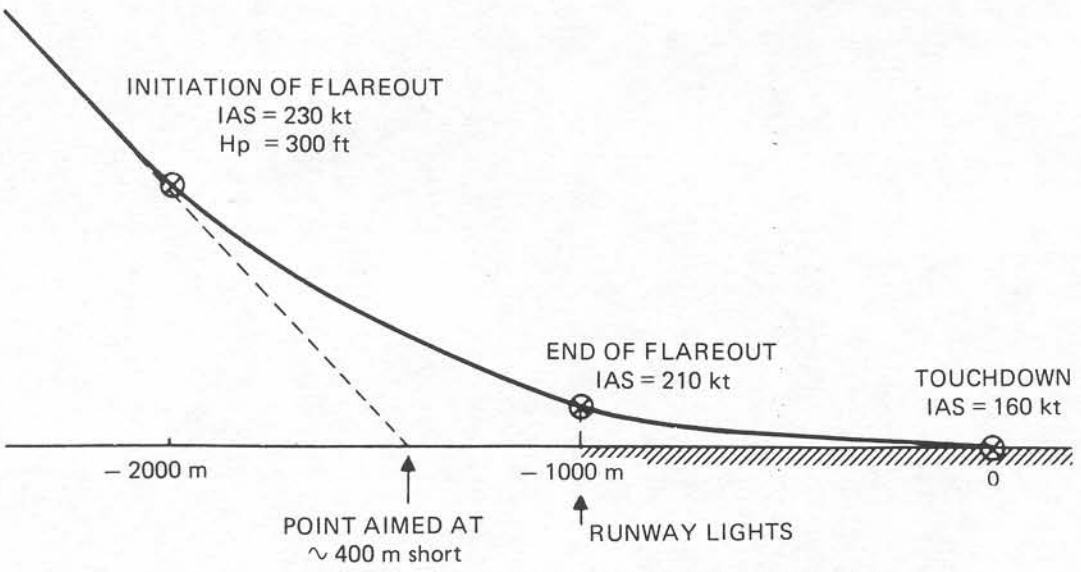
DEAD ENGINE LANDING PRACTICE (DELP)

Configuration and pattern are identical to actual situation.

In addition :
power setting : 6500 rpm
airbrakes : out
go-around at 1000 ft

NOTE : If sharp maneuvers are required, set the «SLATS/FLAPS» selector switch to «NORMAL».





FINAL APPROACH SECTIONAL VIEW

FIGURE 1 – FLAMEOUT PATTERN

5,25.5 - LANDING WITHOUT MACH/AIRSPEED INDICATOR

Fly landing pattern using the angle-of-attack indicator - See para. 2,25.8

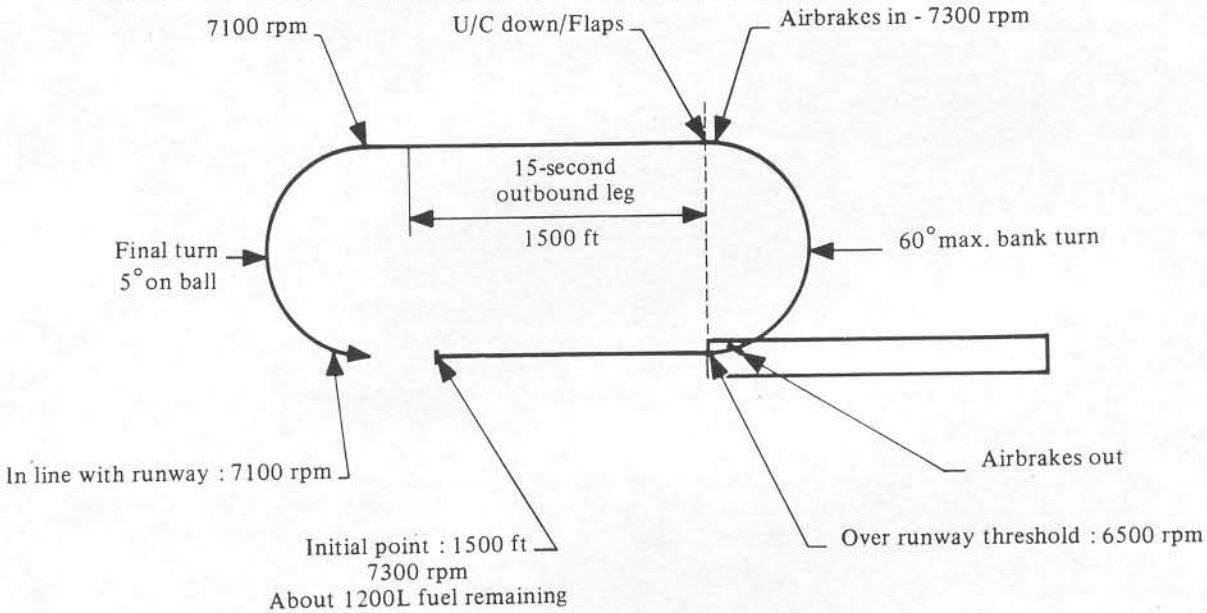


FIGURE 2 – PATTERN WITHOUT MACH/AIRSPEED INDICATOR AND WITHOUT ANGLE-OF-ATTACK INDICATOR

5,25.6 - LANDING AND GO-AROUND IN EMERGENCY REGULATION MODE

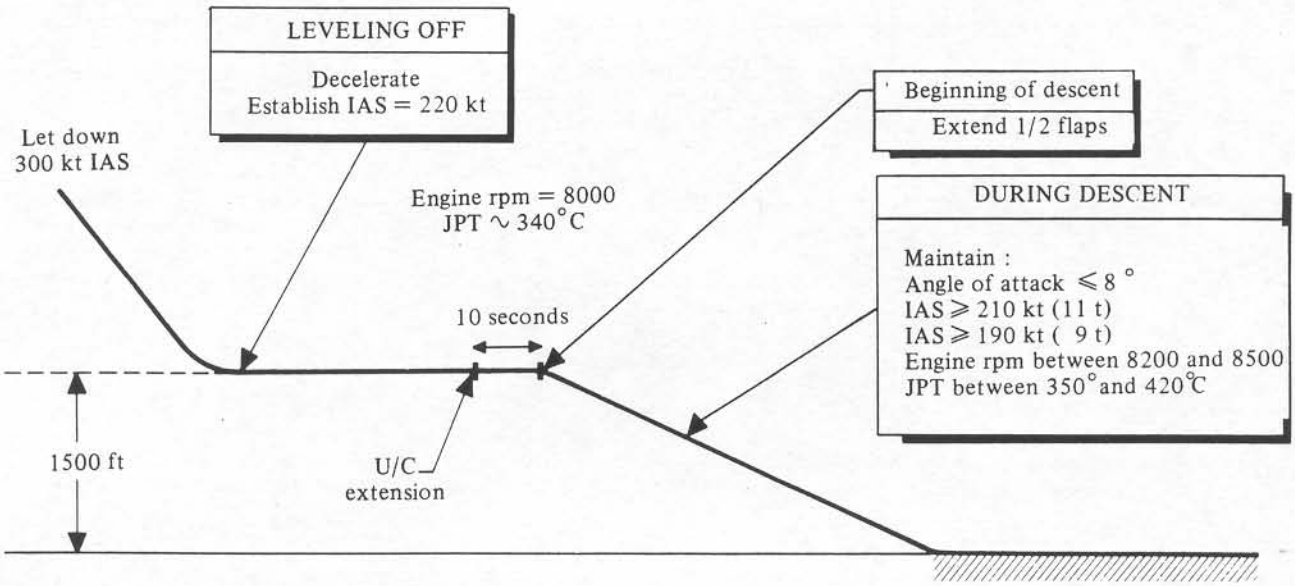


FIGURE 3 – APPROACH AND FINAL IN EMERGENCY REGULATION MODE

Depending on the remaining fuel quantity, GCA level flight at 1500 ft can be maintained only with the U/C up. In all cases, jettison the stores and perform a GCA type approach as shown above.

CAUTION

1- IF GO-AROUND IS NECESSARY, MAKE IT AS SOON AS POSSIBLE, WHILE KEEPING THE CONTROL LEVER FORWARD AND SIMULTANEOUSLY RETRACTING THE U/C. WATCH THE ENGINE RPM WHICH SHOULD IN NO CASE EXCEED 9250.

2- TO LAND ON A HIGH-ELEVATION AIRFIELD (H > 2000 ft), THE ABOVE PROCEDURE CANNOT BE OBSERVED
PERFORM A DELP TYPE APPROACH
GO-AROUND IS NOT ASSURED.

5,25.7 - WHEELS-UP LANDING (on hard runway only)

- Burn up fuel until only about 2 x 100 l remain
- Tighten and lock the harness
- Use all the flaps available and the airbrakes
- If a minimum of 1/2 flaps is not available : EJECT
- Establish i = 10°
- Switch off the LP pumps and the starting pump
- Flare out but do not hold off (avoid touchdown with high nose-up attitude)
- On touchdown :
  . shut down the engine
  . deploy the brake chute
  . close the LP main cock
  . turn off all electrical system switches

WARNING

CRASH LANDING AND DITCHING ARE PROHIBITED.

5,25.8 - STRONG CROSSWIND

- Normal landing pattern, compensating for drift : wind on break side = smaller bank angle (and vice-versa)
- Approach IAS : unchanged except if longitudinal wind component is important with gusts. In this case, add half the value of the longitudinal wind component plus the gust value up to a maximum of 20 kt

Examples :

(a) wind = 60° . . . . . .25/30 kt
add 6 + 5 = 11 rounded up to + 10 kt

(b) wind = 45° . . . . . .25/40 kt
add 9 + 15 = 24, therefore + 20 kt

- Wing low into the wind and touchdown without skidding ; use of the brake chute is unadvisable except if absolutely necessary
  Land on the half-runway opposite to the wind ; if the brake chute has been used, be prepared to jettison it if the aircraft cannot be maintained on the centerline
- Bring the nose wheel on the ground without waiting for the rudder control to become ineffective
- Apply the brakes normally

NOTE : With strong crosswind, retracting the flaps after touchdown may appreciably facilitate aircraft control with the nose wheel steering system. It should however be kept in mind that a great number of landing incidents occur when the pilots have their attention affected by the performance of unusual actions, and that if flap retraction is left to the pilot's judgment, this action must be performed with the greatest degree of attention and not as a reflex action or routine procedure.

5,25.9 - SLIPPERY RUNWAY

- Normal landing pattern
- Deploy the brake chute on touchdown
- Apply the brakes moderately and symmetrically, holding the centerline with the rudder pedals

CAUTION

THE NOSE WHEEL STEERING SYSTEM REACTS WITH A CERTAIN DELAY ; THEREFORE, DO NOT HURRY AND ANTICIPATE TO STOP A CORRECTION.
IT IS UNADVISABLE TO USE FULL DEFLECTION OR HIGH SENSITIVITY.

- In case of uncontrollable skidding, completely release the brakes and push the control stick forward to increase the effectiveness of the nose wheel steering system

5,25.10 - EXCEPTIONAL WEIGHT

- Perform the landing with a shallow nose attitude on final so as to touch down with a R/D < 300 ft/min (at 11 t)

For braking initiation speeds, see para. 2,25.9 SECTION 2

5,55 - INSTRUCTIONS FOR STARTING AND TAXIING UNDER HOT CONDITIONS

5,55.1 - ILLUMINATION OF [EQ.T] LIGHT

This symptom generally occurs as soon as the temperature under shelter is about 45°C. The whole aircraft is very hot and it is normal that the [EQ.T] light goes out only at full power.
The pilot should select the maximum engine rpm consistent with the manoeuvres to be performed, in particular to ensure safe taxiing.

5,80 - SPECIFIC STORE CARRIAGE INSTRUCTIONS

5,80.1 - MAGIC MISSILE CARRIAGE

In the transonic region ($0.9 \leqslant M \leqslant 0.95$) and at airspeeds between 450 and 500 kt, the excitation due to the airflow or the atmospheric turbulence results in missile movements, with a frequency of about 7 Hz, which are almost undamped and may be felt by the pilot.

These movements are not of a divergent nature and are not dangerous ; they may lead to a situation considered uncomfortable by the pilot. If the mission conditions permit, changing the flight parameters should cause this phenomenon to cease.

If vibratory phenomena differing from those described above are felt (definitely lower frequency, different flight conditions, yawing movement), the possibility of a failure is to be considered (yaw damper failure) ; the instructions to be observed are then as follows :

- reduce airspeed
- switch off the autopilot and yaw damper
- avoid high airspeeds at very low altitude and high roll rates
- avoid turbulent areas
- test the flight controls upon return from flight
- report the incident.